ENGINEERING NEWS

IRRIGATING CANALS are multiplying fast in Montana. The Helena *Daily Herald* estimates that 3,000,000 acres of land are covered by canals now under construction. It describes the following canals: The Gallatin Canal Co. was organized in Helena in June, 1888, for operating a canal in Gallatin Co. This canal will be 25 miles long, 38 and 24 ft. wide, and 5 ft. deep. The estimated cost is $79,000 with about 60,000 acres under the canal. The Florence Canal and Reservoir Co. was organized in May, 1888, and takes water from the south fork of Sun river. The length of the canal is 15 miles and the width is 20 ft. on bottom, 45 ft. on top, and the depth is 5 ft.; 150,000 acres of land are under its control. The Sun river Canal Co. was started in 1885, and the scheme includes the irrigation of 2,500,000 acres of land by a network of canals, of which about 200 miles have been constructed at a cost of $250,000. The area to be irrigated lies between the Teton, Missouri and San river, and the Rocky Mountains. The Teton canal is now 20 miles long and will be 30 miles long. It includes an immense flume 1½ miles long made of 2-ft. iron pipe. The old Benton lake is being converted into a storage reservoir, with an area of 21 sq. miles. Mr. CHAS. MCINTYRE is the engineer in charge. This lake will irrigate 40,000 acres of land, and two canals, each 25 miles long, will convey the water to the rich tableland towards Fort Benton. The Chestnut Valley canal takes water from the Missouri river and runs northerly 20 miles from the Half Breed rapids. The Dearborne canal, from Dearborne river, commences in a cañon on the north fork, where the water is diverted by a timber dam. This canal will be 119 miles long, and have 475 miles of lateral ditches; 200,000 acres of land are under the canals.

THE COLORADO WATER SUPPLY CO. has practically completed its canal and is now ready to supply water for irrigation. The main canal, which includes a tunnel one mile long, conducts the water of the Dolores river to 48 miles of main laterals covering 100,000 acres of land in the Montezuma valley, and extensions of these laterals are planned to cover 300,000 acres. The work has cost so far about $450,000. Mr. A. H. HAVEMEYER, the sugar refiner, is heavily interested in the enterprise.

A HOT-WATER ARTESIAN WELL, at Alma, Mich., is interesting in connection with the notes on the Ponce de Leon well, in a late article. A well has just been sunk at the Sanitarium in that city, and on March 22, hot saline water was struck at a depth of 2,876 ft. below the surface. The water had a temperature of 156° F. when brought to the surface. The well has 220 ft. of 8-in. pipe and inside this is 560 ft. of 6-in. and 1,580 ft. of 4-in. pipe, the latter ending in the solid rock. The well has cost $10,000 and will be continued in the hopes of striking gas or oil.

IN THE CORINTH CANAL 1,500,000 cu. metres of material were removed between Jan. 20 and Nov. 30, 1888, or in about 11 months. There yet remains 2,767,000 cu. metres of excavation to finish the cut to the level of 2 metres above the sea-level. The channel excavation is estimated at 1,150,000 cu. metres, to the depth of 8½ m. In addition to this 95,500 cu. m. of masonry and 10,000 cu. m. of rip-rap will be required.

RUSSIAN RAILWAYS, at the end of 1887, aggregated 16,800 miles in length, which is an increase of 10,000 miles in the last 15 years, not including Finnish and Transcaspian lines. The average construction cost of State lines has been $42,500 per kilometre, as compared with German roads costing $65,000 and French roads costing $80,000 per kilometre. In 1886 the number of passengers carried was 38,000,000 and freight amounted to 53,000,000 tons. The locomotives on the roads number 6,500, passenger cars 8,000, and freight cars 123,000. The gross receipts per mile, of the total 70,000,000 miles covered by the trains, were $2,485, and the expenditure was $1,750.

THE INDIAN EXPRESS from Bombay to Lahore traverses 1,130 miles of hot country at the rate of 20 miles per hour. The first-class carriages have wooden seats covered with thin cotton padding, and are the hardest seats possible for a long journey. Bad meals can be secured by giving notice beforehand to the guard; but old travelers usually carry a tiffin-basket with a spirit lamp, and cook bacon, etc., in the lavatory attached to each carriage. So says Mr. W. S. CAINE, M. P., who has recently been making the aforesaid trip.

A BATTLE OF THE BRAKES is being waged in India, and it is reported that the Government has now decided to adopt the automatic vacuum in preference to the Westinghouse, for the North Western Railway. *The Indian Engineer*, on commenting on this decision, says that whether it is right or wrong, it has been arrived at with undue precipitation, and as a consequence the whole question will undoubtedly be reopened.

THE U. S. CIVIL ENGINEERS are not the only body dissatisfied with their professional status. Some 800 "civilian members of the Public Works Department" of India are also vigorously setting forth their grievances and loudly calling upon the Government for redress of alleged wrongs in the form of insufficient pay and inadequate recognition of services.

PAVING BRICKS are made at Kakos, near Buda-Pesth, from carefully selected clay mixed with a little lime. These bricks when moulded are submitted to a pressure of about 3,500 lbs. per sq. in and then burned nearly to vitrification. The product is regular in form, homogeneous, of uniform density, and of great resistance to wear. According to the experiments of Prof. IGNACZ, they have supported without deformation or fissuring a maximum load of over 45,000 lbs. per sq. in., and a mean load of 31,426 lbs. per sq. in. A square metre of this brick paving (1.196 sq. yd.) costs $3.80. In laying this paving, the soil is first consolidated and a bed of ordinary brick masonry is laid; upon this the paving bricks are set in mortar, leaving a joint of 4-10 in. between the blocks to be filled with cement. The dimensions of the brick are 7.87 x 7.87 x 3.9 ins. and they weigh 24 lbs. each. It takes 22 bricks to lay one square yard of paving. The brick foundation is about 6 in. deep. This brick pavement is easy to clean, does not become slippery, and is pleasant to drive over. The only objection is that it is somewhat noisy in the narrower streets.

THE SMITH AVENUE VIADUCT, in St. Paul, Minn., is three-fourths completed. The entire structure will be 2,770 ft. long, made up of four 250-ft. river spans, and plate girders resting on iron piers. The roadway is 25 ft wide with two sidewalks in addition, 8 ft. wide each, and the maximum height above the bottom of the ravine is over 100 ft. The superstructure will have consumed when complete 5,882,000 lbs. of metal, and the truss is figured for a live load of 100 lbs. per square foot.

THE ST. HELEN ISLAND BRIDGE SCHEME, near Montreal, Canada, has been defeated in the railway committee at Ottawa. The reasons advanced by its opponents were obstruction to the steamship channel and the danger of ice-jams and flooding at Montreal.

CHINESE RAILWAY BUILDING is at an end for the present, says a despatch from Tien-Tsin of Feb. 2. All plans are reported as blocked for the extension of the Tien-tsin-Kaiping railway, by a combination of high government officials opposed to the progressive policy of Viceroy LI. The latter has been recently stricken with paralysis, but is now recovering, and will make a vigorous fight in support of his measures.

THE ELECTRIC LIGHT COMPANIES of New York, in bidding for lighting the streets, have doubled their rates where subways have to be used, on the plea that they must pay rent to the subway company. The price bid for light from poles is 35 cts. per night; but with wires in the subways the cost is to be from 65 to 68 cts. for the same hours.

PANAMA CANAL WORK has ceased entirely, says the U. S. Consul at Colon. Up to March 16, about 5,000 of the West Indian negroes formerly employed on the work had returned to their homes. There is great depression in business, and the Panama R. R. is suffering from the loss of local traffic.

THE COMPARATIVE DEADLINESS of "straight" and alternating electric currents seems to be settled, *pro tem.* at least, by the choice of the alternating current for official executions under the new New York State law; which law, by the way, has been introduced in several other State legislatures, and appears likely to soon become universal, should it prove a success in New York. About 1,000 volts seems to ensure death, and 2,000 volts is the proposed current.

IMMIGRATION is falling off, having been in February last only 68½ per cent. as much as in the previous year; in two months ending with February only 72 per cent. as much, and in eight months ending with February only 88 per cent. as much. Every one must rejoice to see this tendency to decrease, not only for political and social reasons, but as indicating that there is now no unnatural business "boom" from which relapse must come.

THE CANADIAN PACIFIC RAILWAY CO. has a bill before the Dominion Parliament by which it is authorized to issue consolidated debenture 4 per cent. stock to the amount of not more than $109,000,000 for the purpose of refunding its outstanding obligations, constructing or purchasing branches and extensions, and for the improvement of its existing railways and other property. The bill is meeting with considerable opposition, many claiming that the company will use the funds thus obtained to carry out a wholesale extension policy. The announcement of the incorporation of the Buffalo, Lackawanna & Pacific Ry. Co. to build a railway from Buffalo, N. Y., to Lewiston, where a bridge is to be built across the Niagara river, is construed to mean that the company intends at an early date to run its trains into Buffalo. The real facts of the case seem to be that the new charter has been obtained by capitalists who intend to sell either their franchise or completed road to either the Delaware, Lackawanna & Western, the Canadian Pacific, or to the competing lines which the new road would parallel. The officers of the new company are given in our railway news columns.

THE MOST SERIOUS RAILWAY ACCIDENT of the week was a rear collision, March 21, between the third and fourth sections of a freight train on the New York, Lake Erie & Western road near Cuba, N. Y. The third section was standing on the main track when it was run into. The caboose and some of the cars were burnt and the engine of the rear section was overturned and badly damaged. No lives were lost. This is one more addition to the long list of collisions between freight trains made up in sections and goes to show that sufficient precautions are not taken in the running of these sections.

THE TWENTY-FOUR-O'CLOCK NOTATION has been adopted by the Chinese railways, the time-table between Tien-tsin and Tong-shan being so denoted, and this notation has also been in use throughout the Japanese empire for more than a year. The report of the Am. Soc. C. E. Committee on Standard Time, published in another column, shows the recent progress in this country, which is not great, perhaps, but encouraging.

BRIDGE AND TRESTLE ACCIDENTS are reported as follows:—On March 17, five bents of the Mojave river bridge (trestle) near Barstow, Cal., were carried away by the flood in the river. Railway traffic was considerably interfered with.—On March 19, a derailed freight car broke through a trestle on the Augusta & Knoxville road, near Augusta, Ga., and several cars were damaged.—On March 23, the Howe truss bridge at Conowingo, Md., on the Columbia & Port Deposit road, was completely destroyed by a fire started by incendiaries. The bridge is stated to have been 100 ft. long, and a temporary trestle has been erected.—The Verrugas Viaduct, on the Oroya Railway, in Peru, has been carried away by a flood; it was 108 ft. high, and a famous structure in its day, having been erected in 1875, and being then the boldest and largest structure of the kind in existence. The traffic of the road is so light that it is said to be very doubtful if the structure is renewed.

LANDSLIDES have occurred on the West Shore and the Fonda & Gloversville railways in this State. Washouts are reported on the Southern Pacific and Central Pacific railways in California.—A heavy fall of earth occurred March 20, at the mouth of the West Alexander tunnel on the Wheeling division of the Baltimore & Ohio; a passenger train was derailed.

THE DAKOTA ARTESIAN WELLS, from Yankton to Pembina, are said to exceed one hundred in number, to range from 500 to 1,000 ft. in depth, and to show a gauge pressure at the mouth of the well of from 160 to 187 lbs. per square inch. This power is utilized for driving machinery.

THE WISCONSIN CENTRAL SYSTEM will probably be united with the Northern Pacific at an early date. The report has so often been in circulation before that it is exciting less attention now than it deserves. The consolidation will probably be by lease, the Northern Pacific paying a percentage of the gross earnings, but making no guarantees. By the acquisition the Northern Pacific will secure a Chicago terminus and this will be likely to incite its chief competitor, the St. Paul, Minneapolis & Manitoba, to extend to the same point.

STRINGING ELECTRICAL WIRES OVER A HOUSE though in no way attached to the house, has been decided by a French tribunal to be an injury to the house-owner. The claim of the electrical company, that the owner of the house had no rights in the space above that house, was met by the decision that all the space capable of being in any way utilizedb elonged to him.

RULES FOR FINDING NUMBER OF BRICK IN CIRCULAR AND EGG-SHAPED SEWERS.—Mr. MEADOWS, of the Canadian Society of Civil Engineers, gives the following rules for the above, using brick 8½ in. × 2½ ins. × 4 ins., with ½-in. joints: For circular sewers, multiply the internal diameter of sewer (in inches) by 1.1421, to find the number of bricks in first ring; then add 10.28 for each additional ring For egg-shaped sewers, multiply the internal transverse diameter (in inches) of the sewer by 1.4418 for first ring, and add 10.28 as before for each additional ring.

A New Method of the Microscopical Examination of Water.*

In making microscopical† examinations of potable waters, it is entirely impracticable, on account of their relative purity, to proceed directly. Repeated examinations of random samples might yield absolutely nothing, although filtration of a few cubic centimeters through a fine cloth might show that in the same water there were abundant microscopic forms.

The importance of being able to ascertain the presence of these microscopic organisms, and to determine their number and species in any given sample of water, is self-evident. It is important, not only from a purely scientific, but also from a sanitary point of view, to know precisely what is contained in drinking water. Again, large manufacturing interests are dependent upon the purity of the water suppled to them through filters or otherwise, while many large towns depend upon the efficiency of filters for the purity of their water supply. A microscopical examination of the water before and after filtration shows very clearly the actual work which the filter accomplishes, in a way that it is impossible for chemical analysis to do. From a scientific and sanitary point of view, microscopical examinations are accordingly of great value, both as a means of the study of the organisms themselves, and of the influences of changes in the water upon their growth, life and death, as well as the counter effects produced upon the water by them. For making such examinations there have been hitherto, so far as I know, but two methods employed. One of these is that proposed by Dr. J. D. MCDONALD in his "Guide to Microscopical Examination of Water" (J. & A. Churchill, London, 1883). In this method the sample to be examined is put into a tall glass cylinder, at the bottom of which is a watch-glass suspended by a platinum wire. This is allowed to stand for 48 hours, in order that the matters held in suspension may settle into the watch-glass at the bottom. The upper water is then syphoned off, and the contents of the watch-glass examined under the microscope.

The other method, the origin of which I do not know, is used at present by the Massachusetts State Board of Health. In this method a given quantity of water is passed through a fine linen or cotton cloth tied to the lower end of a funnel. After the water has passed through it, the cloth is removed, and cautiously reversed over the end of a glass tube, the numerous objects which have been caught upon the cloth being now upon the outside. A slide is then placed under the cloth, and a puff of air blown through the tube. The moisture contained in the cloth collects in a drop, which falls upon the slide, carrying with it theoretically the materials filtered out of the water. The slide is then examined under the microscope, and the organisms obtained counted. Both these methods are open to very serious objections, and are so crude that no fair estimate of the number of organisms contained in a given sample of water can be formed. In the case of the first method, I have found that by no means all of the microscopic organisms settle to the bottom, even when the water is left standing a much longer time than 48 hours, as there are many which have about the same specific gravity as water, and consequently do not settle. This source of error becomes greater in proportion as the water to be examined becomes purer. In the case of ordinary drinking water, the sediment is very inconsiderable, although there are large numbers of organisms held in suspension. Under ordinary circumstances, water left standing in this way gives an excellent opportunity for the organisms present to increase. Especially is this the case with filtered water, where the increase is surprisingly rapid. From this it is plain that the sediment in the watch-glass does not represent what was originally in the water, but only a small part of that amount plus a part of the increase which has since taken place. In the second method, if the cloth be examined microscopically after presumably all the microscopic organisms have been removed, it will often be found that a very large number are stuck in the meshes of the cloth.

For these two methods I have substituted one which, although far from perfect, gives much better results. I have now been using it for four months in making microscopical examinations of water for the city of Boston.

The new method is as follows. A known quantity of water (I have found 100 cu. centimetres a convenient unit) is put into a funnel in the tube of which is half an inch in depth of sand (24 to 30 grains to the inch). The sand is held in place by a stop made of a roll of brass wire gauze, which gives free passage to the water, while it holds the sand in place. Through this the water is filtered, the sand holding back the microscopic forms. The experiments which I have tried, to test whether all the organisms are removed or not, have proven conclusively the efficiency of the sand in holding back all the microscopic organisms in the water. After all the water has passed through, the stop is removed, and 1 cu. centimetre of distilled water (the water which has just been filtered will answer as well) is thrown into the funnel by means of a pipette. This washes the sides of the funnel, and carries the sand with it down into a watch-glass which is held underneath to receive it. On falling into the watch-glass, the grains of sand separate and sink to the bottom, leaving the lighter organisms which have been caught between them mostly suspended in the water. By stirring this wash-water a more even distribution of the organisms is obtained, and if any have been carried to the bottom by the falling sand, they are liberated; so that if the wash-water be poured off, and the sand examined under the microscope, it will be found that there are no more organisms among it than might be expected. Some of the water standing above the sand is immediately transferred to a slide containing a chamber, the capacity of which is 1 cu. millimetre. All the microscopic organisms contained in this chamber are then counted under the microscope, and from the result the total number of organisms in the original sample is computed. I have found this cubic millimetre surprisingly representative of the whole mass of the wash-water, as far as the numbers go, although, as would naturally be expected, the species vary largely in different samples.

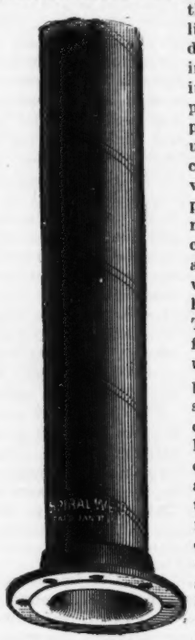
This method, as the first which can fairly be called quantitative, opens up a new field, having wide and practical applications. It is to be hoped that microscopical examinations may hereafter take their proper place alongside of bacteriological and chemical analyses, to which they must form important adjuncts.

* A communication to *Science* by Mr. A. L. KEAN, of the Mass. Inst. Technology.

† It is convenient to designate by "microscopic" all forms of life visible only by means of the microscope, exclusive of the bacteria.

Spirally Welded Steel Tubes.

The recent visit of The American Institute of Mining Engineers to the new works of the Spiral Weld Tube Co. in East Orange, N. J., has brought to the attention of engineers in all departments a most interesting and important industry of which but little has been known up to this time. The spiral weld steel tube is an addition of the greatest practical value to the materials at the command of the engineer. It combines lightness with strength to a degree never before attained in tube making, and is finding its way into use for all purposes for which pressure pipes are needed. These uses include water-works construction and the conveyance and distribution of petroleum, natural and illuminating gas, steam and compressed air, mine drainage, and many purposes for which light tubes have not hitherto been employed. They are entirely practical for all purposes, and their use is attended with an important economy to the consumer, not alone in first cost, but in freights, handling, and coupling. They can be made of any length admitting of transportation, and of any diameter for which the rolling mills can furnish stock. The works are now making 6, 8, and 10-in. tubes, and are building machines which will extend the range of diameter to 24 ins. The next step will probably carry the diameter up to 36 ins., and perhaps larger if such tubes are needed in quantities which would justify building such heavy machines. The longest tube thus far made is 44 ft. 6 ins. between ends; but as 30 ft. is the greatest practicable shipping length, there is no advantage in exceeding that length.



A Spirally Welded Stee Tube.

The process of manufacture is interesting, and has called for the construction of very accurate machinery. It is quite automatic, and demands no previous mechanical training on the part of the operator. The stock is rolled in grooves to the width required, and as long as possible. The ends of these strips of steel are welded together in a machine designed for the purpose, and the ribbon of 90 or 100 ft. is reeled and passed to the pipe machine. This has four functions,—feeding, bending, heating, and hammering. The end of the ribbon is secured to a guide table set at the angle of the spiral and is fed in by geared rolls. No mandrel is used, but the pipe-mold is of such form as to keep the size and alignment accurate. Projecting into the pipe, for a distance a little greater than the width of the skelp used, is an anvil, water cooled and protected by a shield of fire brick. The furnace is a small box of cast-iron, lined with refractory material, containing two nozzles, delivering blow-pipe, flames of gas and air. One of these nozzles heats the edge of the skelp and the other the edge at the end of the formed pipe. The entering skelp meets the hot end of the pipe in the focus of these flames, a rapid striking hammer welds them as they move across the face of the anvil, the crimper also acting against the anvil, imparts the desired curvature, and the pipe is made. It is a curious sight to see cold skelp entering one end of the machine, and cold pipe, with a perfectly welded seam, emerging from the other end scarcely a foot away. Heat is applied only to the edges which are lapped and welded, and the body of the stock is rarely made hot enough to mar the planish it receives during the final passes in the rolling mill. The feed is variable, according to the heat, and may be varied at the pleasure of the operator. The usual production is a foot per minute to each machine. No scarping or other preparation of the stock is necessary, and owing to the reducing character of the flame, no flux is employed or

needed. It is a beautiful and simple operation, and its economies are obvious.

The great advantage of this method of manufacture is found in the surprising strengths attainable with comparatively light gauges of metal. The spirally welded pipe is remarkably stiff, and will carry pressures which would be quite unsafe with longitudinal welds. Internal strains, exerted circumferentially, do not subject the weld to a transverse stress, and consequently do not tend to open it. On the contrary, a spirally welded pipe which leaks at any pressure from one pound to twenty, is likely to become tight at 100 lbs., and remain so as the pressure increases. The reason for this seeming paradox will be found by any one who will experiment by tightly pinching one end of a paper tube spirally wound, and blowing into the other end. In this case we have only the edges of the paper in contact, but with a very slight internal pressure it becomes so tight that it will burst before it will leak. The strains to which a longitudinal seam are subjected tend to pull them apart; but the same strains, exerted upon a seam obliquely circumferential, do not tend to separate it. In this case the weld is a helical reinforcement. This is best shown by the following table of proof strengths and ultimate of different diameters of spiral weld tubing, from different gauges of stock. The steel from which they are made has a proof strength (or elastic limit) of 45,000 lbs. and an ultimate strength of 62,500 to 65,000 lbs.

Diam. Pipe.	*Gauge.*	*Proof Strength per sq. in.*	*Ultimate Strength per sq. in.*	*Weight per foot lbs.*
6	18	653	1062	3.09
	16	866	1408	4.10
8	16	650	1056	5.47
	14	830	1349	6.98
10	16	520	845	6.83
	14	664	1079	8.72
	12	872	1417	11.44
12	16	433	704	8.20
	14	553	899	10.46
	12	727	1181	13.74
	10	893	1451	16.90
14	16	371	603	9.57
	14	474	771	12.20
	12	623	1012	16.02
	10	765	1244	19.72
16	16	325	528	10.93
	14	415	674	13.95
	12	545	886	18.30
	10	670	1088	22.54
	8	825	1341	27.72
18	14	369	599	15.69
	12	484	787	20.69
	10	596	968	25.35
	8	733	1192	31.19
20	14	332	539	17.44
	12	436	709	22.28
	10	536	871	28.16
	8	660	1073	34.66
22	14	302	490	19.18
	12	396	644	25.27
	10	487	791	30.98
	8	600	975	38.12
24	14	277	449	20.92
	12	363	590	27.48
	10	446	726	33.80
	8	550	894	41 .60

The coupling of spirally welded tubes has been the subject of much study and experiment, but it has been found that the form of coupling suited to the widest range of uses in the "Trumpet Flange," shown in our illustration. In this form of joint, no dependence is placed upon the contact of the flange faces against each other or any interposed substance. The end of the pipe is turned over flat, and is brought in contact with the gasket, the cast-iron flange acting merely as a follower to press the pipe ends firmly against the gasket. This is the best form of joint known, and with suitable gaskets is made tight against steam, air, petroleum, water or natural gas without any difficulty—which is more than can be said of screw threads, however well cut, or of any form of union between the pipe and its flange. The company have a large line of couplings designed to various uses, but the "Trumpet Flange," so called from its expanded mouth, meets every requirement thus far encountered. It permits the insertion of flanged reducers, T's, crosses, Y's, and other spiral fittings whenever needed. It also has the advantage of being a joint which can be made in the field. If the pipe needs to be cut, the flange is slipped on, and the end of the pipe can be turned over cold by any one who can use a hammer. A man with any judgment can hold the end of a tube between his knees and in a very few minutes expand the metal flat against the face of the cast-iron flange without starting a crack.

The question of the durability of light-pressure pipe has been answered by the engineering experience of more than a quarter of a century on the Pacific Coast. In reviewing this experience in a paper before the British Iron & Steel Institute (Vol. 1, 1886), Mr. HAMILTON SMITH, Jr. C. E., predicts the pipe of the future as follows: "The ideal conduit for high pressures is a welded steel tube; such tubes could probably be subjected to a tensile strain of 250,000 lbs. with perfect safety, and would be much preferable to riveted pipe, not only on account of superior strength, but also by reason of almost perfect interior smoothness. . . . The adaptation of a superior and cheap metal, such as mild steel, for conduits, will permit the construction of hydraulic works in many parts of the world which now appear to be impracticable, owing to the cost of many of the methods still in use for the transportation of water."

The fact that spirally welded steel tubes are creating an excitement on the Pacific Coast, where a branch manufactory is already called for, shows that those who know most about light pipes appreciate them most highly.

The business of The Spiral Weld Tube Co. is neither speculative nor experimental. They have built and equipped an extensive and beautiful plant, and made no announcements until they were manufacturing and shipping tubes. They have conducted their experimental work quietly, and are now ready for as large and rapid a development as the requirements of engineering work demands. The New York office of the Company is in Temple Court, 5 and 7 Beekman St., and its directors are: JAMES C. BAYLES, President; WM. S. CHURCH, Secretary; GEO. C. HALLET, Treasurer; HENRY R. TOWNE, S. T. WELLMAN, JAMES P. WITHEROW, JOHN A. PRICE, GEO. BURNHAM, Jr., and DAVID BINGHAM.

Proportion of Rainfall Reaching the Sewers.

BY EMIL KUICHLING, M. AM. SOC. C. E.

(*Concluded from page 260.*)

As it may be of interest to compare these four different formulas with each other, as well as with reliable observations, they have for convenience all been reduced to the same notation by the writer; and to make the first and third named applicable to other rates of rainfall than one inch per hour, this factor has been introduced in making the necessary transformation. Accordingly, with the following notation: (Q) = maximum discharge of the outlet sewer, in cubic feet per second; (r) = maximum rate of rainfall in inches per hour, which is practically the same as if expressed in cubic feet per acre per second; (A) = magnitude of the drainage area in acres; and (s) = the sine of the general slope of the surface or the quotient of the average fall divided by the average length, we will have:

(1.) HAWKSLEY .... $Q = 3.946\, A\, r \left(\frac{S}{A\, r}\right)^{\frac{1}{2}}$

(2.) BURKLI-ZIEGLER $Q = \left(\frac{1.757 \text{ to } 4.218}{\text{Average } 3.515}\right) A\, r \left(\frac{S}{A}\right)^{\frac{1}{2}}$

(3.) ADAMS..... $Q = 1.035\, A\, r \left(\frac{S}{A^2 r^2}\right)^{\frac{1}{16}}$

(4.) MCMATH..... $Q = \left(\frac{1.234 \text{ to } 2.086}{\text{Average } 2.488}\right) A\, r \left(\frac{S}{A}\right)^{\frac{1}{2}}$

It may also be remarked that the first and third expressions relate to ordinary urban conditions of surface, and are designed to apply best where $r = 1$; while in the second and fourth expressions the smaller coefficients refer to suburban, and the larger to densely populated districts, the average referring to the same conditions assumed in the first and third.

Applying the above formulas to the case of 177.6 acres of territory drained by the Court and William Sts. outlet sewer in the city, which might perhaps be considered as presenting an average urban surface, since about 38 per cent. of these may be regarded as impervious; and remembering that the average grade of the various sewers in this district is $s = \frac{1}{170}$, while on Sept. 16, 1888, a rainfall of $r = 0.517$ ins. per hour lasted 50 minutes and contributed 38.1 per cent. of the same to the sewers at the time of maximum discharge, we shall find the following computed value for the ratio $\left(\frac{Q}{A\, r}\right)$ of the rainfall to the sewer discharge: 35.3 per cent. from Eq. 1; 26.6 per cent. from Eq. 2; 31.8 per cent. from Eq. 3; and 31.6 per cent. from Eq. 4. For this particular case, therefore, the Hawksley formula gives the nearest approximation to the observed maximum flow. It will also be observed that in formulas 1 and 3, the said ratio $\left(\frac{Q}{A\, r}\right)$ will diminish as the intensity of the rainfall increases; thus for the preceding conditions, but with $r = 2.70$, the values of said ratio are reduced to 23.4 per cent. from Eq. 1 and to 27.7 per cent. from Eq. 3; in Equations 2 and 4, on the other hand, the ratio for a given area is not changed by any alterations of the intensity (r). The writer is of opinion that there is a defect in formulas 1 and 3 on this account, particularly in the case of relatively small drainage areas, since the fundamental principles of hydraulics teach that the resistances to flow diminish rapidly with an increase of depth or volume; hence, while the said percentages may perhaps not increase perceptibly within the range of usual intensities, there is certainly no reason apparent why they should diminish when the rate of rainfall increases. The only justification for such a diminution lies in the circumstance that very heavy intensities usually last only a short time, and that consequently the whole area may not be contributing to the observed maximum discharge; but as this depends entirely upon form, magnitude, and slope of the territory, it is obvious that the said formulas must be used with great caution.

The safer method will be to estimate the probable future amount of impervious surface on the given area, either with reference to the density of population as heretofore pointed out, or in any other more reliable manner that may be devised, and to assume that all of the water which falls upon such surface will run off without loss; further, since the topography of the area is supposed to be known, the grades and lengths of the longest tributaries to the outlet-sewer can readily be determined, as well as their approximate diameters, and thence also the velocities of flow therein. From these elements, the time required for the flood-waters to reach the outlet sewer from the most distant points in the area can next be found, and when the relation between the probable maximum intensity of the rain and its corresponding duration are known, as exhibited in the preceding paper, the maximum rate of rainfall belonging to the time so found can then be deduced. By proceeding in this manner, it is believed that the least error will accrue in the results, and that the dimensions of a sewer so computed will be found adequate until the assumed amount of impervious surface or density of population has been exceeded. On this basis, also, the computations for the east side trunk sewer and its principal tributaries have been carried out systematically, and the errors that may on closer examination be found therein are such as emanate from an over or under estimate of the future density of population, as already set forth. It may be urged that the process indicated is nothing more than a crude approximation, and that some one of the various empirical formulas might as well have been applied; but to this it may be answered that the method is at all events intelligible and rational, besides being founded upon a somewhat better array of ascertained facts than is the case with the empirical formulas mentioned; it also has the merit of compelling the exercise of an engineer's judgment and discretion with respect to the future of particular localities of a city, or even of different portions of the same large drainage area, instead of dealing alike with all. Very frequently we meet the statement that formulas of the above character should be used intelligently, or that the results obtained therefrom should be modified in accordance with the dictates of practical judgment; but it rarely happens that the history and composition of such formulas become known to the majority of those who may be called upon to apply them; and hence a process in which every single component

can be thoroughly scrutinized and amended to suit different circumstances will generally prove to be safer than the ready-made average devices.

The Northwestern Steam Coupling and Trap.

It is difficult to realize, when one remembers with what almost universal skepticism steam heating from the locomotive was looked upon but little more than two years ago, how great has been the progress since that date, and how comparatively little remains to be accomplished. Something like twenty different "systems," as each man prefers to call his own combination, now exist in practical form, and have had more or less success; thousands of cars are in use equipped with steam heat; several important lines have nearly all their cars equipped; and there are only a few very foolish men remaining who venture to question that steam heating from the locomotive is already the standard system of the country, and will in few a years more be practically universal. No such general study and active progress in any decided change of railway practice has ever before been known.

It would be strange if much had not been done by such general activity to simplify and sharply define the requirements of the problem, and these—the still indeterminate elements which it is desirable to unify practice on—may be said to be reduced to three, of which only one is really pressing,—the selection of a uniform standard steam coupling. The two less important, but still important, elements are, the mode of connecting this coupling with the fixed steam pipes of the car, and the form of steam trap by which the water of condensation is discharged.

The two latter are less important simply because uniformity of practice in regard to them is not in any sense essential, however desirable; that is to say, as much time as desired may be taken in gradually determining the best form for them before any attempt is made to agree on any one or two or three forms as the best; but the steam coupling proper ought plainly to be uniform, and until some one form has been agreed on, progress in steam heating cannot be expected to be as rapid as it otherwise would be.

The Northwestern Modern Car Heating and Lighting Co., of St. Paul, Minn., among others, have been experimenting practically for the past two or three years, and have now had several trains running for two winters; and claim, not without some strong apparent reasons, that their system as a whole is somewhat simpler and more effectual than others now prominently before the public; but the claim which they now more particularly present, and in which we are disposed to take most interest and to regard as most reasonable, is that their form of coupling proper, apart from its connecting parts, is the most suitable for adoption as a standard of any now before the public, being equally applicable to any form of connection with the fixed pipes, as well as simple, cheap, and serviceable. The more closely the device is studied, it appears to us, the more clearly it will appear that it possesses these last mentioned qualifications.

We also understand, and we are authorized to state, that the Company recognizes that no coupling can rationally look for recommendation and endorsement as a general standard if its proprietors are thereafter left free to exact any price which they please for its use, and that therefore they propose to formally offer at the proper time, in case their coupling should commend itself to the Master Car Builders' Association as a suitable standard, to bind themselves to furnish it to any railway or rival car-heating company for a uniform royalty of *five dollars* per car over cost of manufacture, in form suitable for use either with hose or metallic connections. This proposition, if carried out, will obviate the greatest and all but insuperable objection to the recommendation of any particular coupler except some unpatented one like the Westinghouse; and in our judgment some agreement of this kind should be made a *sine qua non* for even considering the possible merits of any particular form of patented coupling as a standard. No one can reasonably complain of so moderate a royalty as $5.00 even when a monopoly is practically conferred, and it would be ridiculous to let the question of adoption hang upon the existence or non existence of so small a royalty. On the other hand, no rational railway officer would be justified in recommending any patented device without such agreement, for the railway public would practically be delivered helpless into the hands of patentees, unless the action had become of no effect by general neglect.

There are three distinct types of steam coupling connections, and practically only three, by which the necessary flexibility is secured.

1. *Hose connections*, as with the Westinghouse air-brake coupling, most such couplings requiring the complete flexibility of the hose to couple, and being incapable of use with the more rigid metallic connections.

2. *Flexible joint metallic connections*, like that here illustrated. Many different types of such connections exist, with ball and slip joints, as well as the purely rotary type illustrated.

3. *Coil connections*, in which the needed flexibility is obtained by the spring of a coil of pipe.

The ideal standard coupling should be equally adapted for any or all of these types of connections, since no one can now be sure which will finally prevail, and it is a great merit of that illustrated that it is so adaptable. The two halves of the coupling are simply brought into contact without any twisting or grinding motion, and then the two quadrant wedges shown, which revolve on a pin, are pushed down to engage in the slotted lug of the opposite coupling, lightly tapped with a hammer to compress the packings and bring them into close contact, and the coupling is complete. To disengage, it is only necessary to loosen the wedges with the hand or a tap of a hammer, and the coupling falls apart; or, if this be neglected, or the train breaks in two from any cause, the small chain or wire cord, attached to the wedges in the position shown, pulls them free before any strain falls on the coupling, and the two halves fall apart.

The coupling will not disengage accidentally, even if turned upside down, but grows tighter instead.

No automatic valve is used to prevent the escape of steam in case of disengagement by breaking in two of train, nor is any needed. The steam is rather allowed to escape freely until the valve is shut on the inside of the car, thus clearing the pipes completely of steam if an accident be imminent, or letting out a cloud of steam which at once calls attention to the break-away, even if the automatic brakes be not on the cars to bring them to a stop.

It will be seen, therefore, that this type of coupling is applicable to any form of metallic connection if something better than the particular form shown now or hereafter exists. A like advantage can hardly obtain with a coupling which requires any kind of a twisting motion to engage or disengage.

To adapt the coupling for a hose, all that is necessary is to substitute for the pipe socket shown a tapering or straight-ribbed pipe for the hose to slip over, as with the air-brake couplings. On the other hand, the latter type of coupling does not appear to admit of use with anything but a hose.

A rotary motion in coupling has also a certain disadvantage when there is dust or sand on the packing or "valve-seat," since it tends to destroy its surface. This packing, in the Northwestern coupling, is a ring of vulcabeston, which is found to answer better than any form of rubber, since it is practically indestructible by steam, while sufficiently elastic to make a perfectly tight joint, even if particles of dust, sand, or even a small pebble, be left on the surface. It is held in place by a construction sufficiently evident from the engraving, an interior nut provided with projecting ridge on its upper corner holding it firmly in a socket provided; the vulcabeston surface standing slightly above the adjacent metallic surfaces. It will be ap-

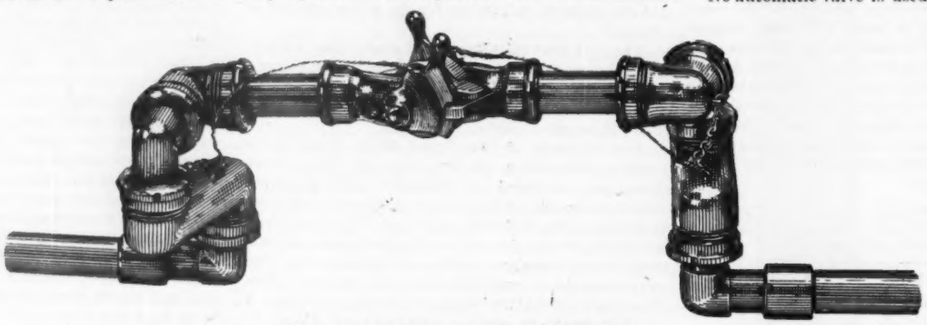


Fig. 1. Coupling Connected and in Service.

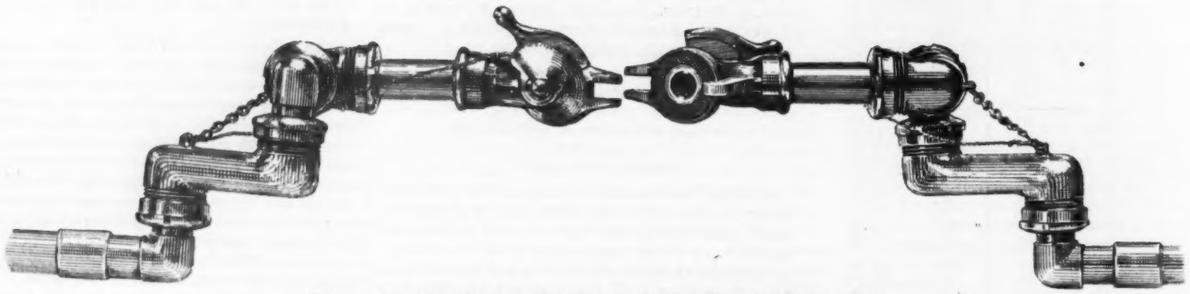


Fig. 2. Coupling Disconnecting Automatically; Showing Construction.

The Northwestern Steam Coupling and Flexible Metallic Connections.

parent that it is but a moment's work to renew the vulcabeston at any time; but in practice they last through the season easily, and often much longer.

It is certainly possible that the permanent type of coupling connection will prove to be the hose, as it has certain great advantages; but such hose as is now manufactured and available does not stand the steam well, is liable to sudden breakages, is not durable, and will not stand high pressures, which are especially desirable for quickly warming up cold cars. It is possible, however, that some new make of hose may at any time remedy these imperfections and secure general preference. On the other hand, it is claimed, with some show of reason, for the type of metallic connection illustrated, as well as for some others, that it is so convenient, cheap, and durable as to leave no advantage in a hose, however perfected.

The critical feature of any such metallic connection is the form of flexible joint, and the Northwestern joint we show to enlarged (half) size in Fig. 3. A couple of turns of the male screw are cut away at the top. The collar or packing nut is then slipped up on the nipple pipe as far as possible, and the interior space filled with vulcabeston packing.

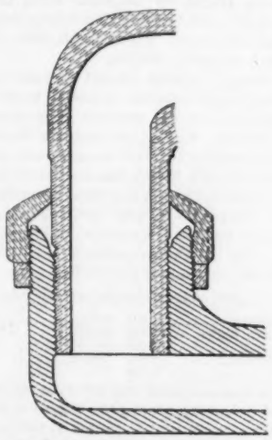


Fig. 3. Section of Flexible Joint. (Half full-size.)

Screwing down this nut, the packing is not only firmly compressed, but becomes engaged with the female threads in the space where the male threads are cut away. The small jam-nut ring is then screwed up, and the result is a perfectly steam-tight joint which yet is perfectly flexible. Any steam, to escape, must first travel around sixteen turns or so of close-fitting thread and then work its way through the packing. Practically, it is stated, not a particle escapes, and the joint requires no attention the season through, and the advantage of this perfect steam-tightness is deemed to more than compensate for the single extra joint which is required as compared with the ball and socket type, which admits of motion in more than one plane.

It will be seen that there are four of these flexible joints on each side of the coupling, but only two special parts are required for each half of the coupling, each part carrying two of the joints, the remaining parts consisting of ordinary pipe fittings only. Thus three pairs of small special parts only constitute the equipment of a car, and the coupling and connection complete is a simpler affair than appears at first sight. The complete connection allows the most perfect freedom of motion in all directions between the two cars up to a limit of nearly 14 ins. When that limit is approached by a separation of the cars, the coupling automatically separates. To prevent the motion all concentrating itself on one side of the connection, so that a motion of 8 ins. might cause a joint to unscrew one turn, a check-chain is applied, as shown in Figs. 1 and 2, restricting the motion so that no such rotation can occur.

The form of trap used by this company is shown in Fig. 4. It is constructed with an inlet for the steam and two outlets, one of which is controlled by a float valve which is raised by the water collecting within the trap, and the other by a double-acting weighted or balanced valve operating to close the outlet as soon as steam is introduced into the trap and to open when the steam is shut off. As the trap communicates with the lowest part of the pipe, the water of condensation naturally forming in the pipe flows into the traps, and the water rising within the trap acts upon the float and raises the valve connected therewith, allowing the water to pass out through this opening as long as the float and valve are thus suspended. When the steam is cut off, the weight on the opposite valve raises it to

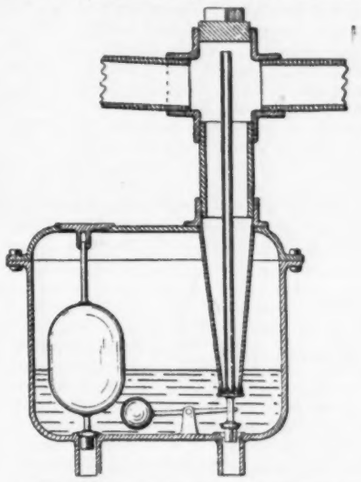


Fig. 4. The Northwestern Steam Trap.

its normal position and allows the remaining water to pass out through this valve. A small steam pipe is located centrally in the inlet pipe, in order to prevent the possibility of freezing at the neck of the inlet pipe. The upper end of this pipe is always open to steam and a sufficient amount delivered at its lower extremity to prevent the ice from forming at this point, so that a free outlet from the trap is insured. A small perforation in the cone, as shown near the top, prevents the formation of a pressure of air, due to gradual increase of condensed water, which will prevent the trap from rising.

The Northwestern company have two systems of piping in use, in one of which the coupling is overhead and in the other under the draw bar. We have left ourselves no space to describe these piping systems in details, nor does it particularly matter, since, given the coupling and connections and the trap, almost any system of piping can be used, with or without a hot water circulation. In the overhead system, the heating is by hot water, circulation being maintained by passing the water through a drum heater. The trap is in the center of the car. The drum consists of an inner and outer shell joined at one end to a common head and at the other end to independent heads, leaving a space for the circulation of steam between them. The drum is provided with an inlet pipe for the steam, which passes through the center of the inner drum and secured in the independent head for this drum at one end, and passes out through the head common to both drums at the other end.

It will be seen that steam passes through this pipe and is carried through the inner drum and returned to the outside of this drum to the outlet pipe which connects with the trap. The drums are preferably inclined toward the steam outlet pipe, in order that all the water may be collected at this point and passed out through the trap.

By the underneath system, there is a trap at each end of the car, close to the coupling, and the heating is by direct radiation. There is no doubt that hot water heating has certain advantages over steam, especially in mild weather, but in our judgment the importance of the difference is often exaggerated.

Tests of the overhead system above described have been going on on the Chicago, St. Paul, Minneapolis & Omaha Railway, on a train running between St. Paul and Black River Falls, 114 miles, for the past two winters. Of the train now in service, a recent note of Mr. H. L. PRESTON, M. C. B., says that "there has been no trouble from leakage, no renewals of packing or tightening necessary, and no trouble from freezing or difficulty in other respects."

A train on the underneath system has been running on the Northern Pacific R. R., for the past three winters, between Brainerd and Duluth, 128 miles. A recent note of Mr. W. T. SMALL, Supt. M. P., etc., March 21, 1889, says:

While I have not a complete daily record of the performance of your steam heating apparatus, I would state in a general way that it is giving entire satisfaction. It has been in use during the entire winter on a train of three cars running between Brainerd and Duluth, for several days at a time, the thermometer averaging 20° below zero, and an average temperature of 70° to 75° was maintained within the cars, with a pressure of from 7 to 12 lbs. of steam from the engines. All pipes, couplings and traps have worked successfully, and have given no trouble in freezing or leaking. I think the improvement you have made in the coupling over the previous year was one of great advantage. So far as my observation goes, your system of heating is the most successful of any we have ever tried on this road, or observed on any other road. I think I can say that your apparatus may reasonably be expected to work successfully on any road under usual conditions of climate.

We think the coupling and connections shown, especially, will be generally admitted to have very great merits.

Railways in Australasia.

The railways in the British colonies of Australia and New Zealand have been in many cases an expensive lesson in economical engineering, as they were, in the early days of colonial railways at least, intended to be built on the substantial and heavy style adopted in England, without regard to the requirements of the traffic of the new country. In England, the heavy traffic warrants a heavy type of construction; but in the colonies, where the prosperity depends to a large extent upon the opening up of the country by railway lines, the first principle should have been to build the maximum amount of road for the minimum amount of money, of course within reasonable limits, and with due regard to the traffic of the near future. Such a course of proceeding, followed up by a steady improvement of the roads to meet the requirements of a growing traffic, as has been done in this country, would have been in the line of true economy, and the colonies have already begun to see that English practice in railway construction and equipment is not the best under all circumstances, and cannot be universally adopted in all its details if economy, in its broad meaning, is to be taken into account.

The subject of the cost of construction and operation of these colonial lines has always been one of interest to railway engineers, and we have therefore taken the following information from a consular report by Mr. G. W. GRIFFIN, which has only recently been published, although dated in April, 1888.

There are, it is stated, more miles of railway in the Australasian colonies, in proportion to the population, than in any other country except the United States. The total number of miles open at the end of 1887 was 9,305 miles, and estimating the population at 3,500,000, there would be 380 persons per mile. In Great Britain there are 1,895 persons per mile; in Germany, 2,063; in France, 2,110, and in the United States, 370. The following table shows the mileage in operation in the several colonies at the close of 1887, and also the mileage under construction at the time of the report; other lines were then projected, and in all the colonies large sums had been voted for new construction.

Mileage of Railways in Australasia.

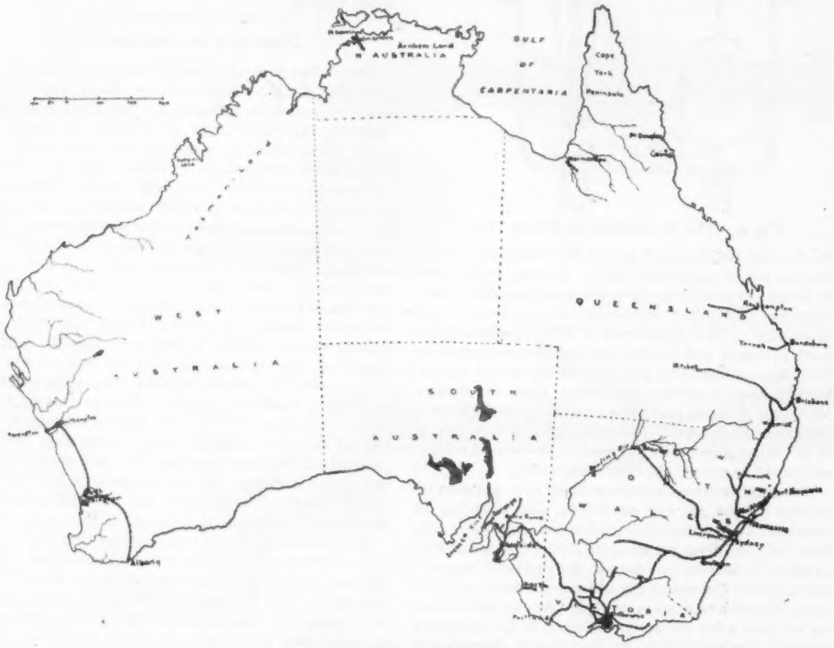
Colony	*Miles open in 1870.*	*Miles open in 1887.*	*Miles under construct'n.*
New South Wales	335	1,924	307
Victoria	274	1,888	316
Queensland	206	1,655	697
South Australia	133	1,572	417
Western Australia	0	154	46
New Zealand	0	1,809	171
Tasmania	0	303	138
Total	948	9,305	2,092

The first railway projected in Australia was in 1846, when it was proposed to connect Sydney with Goulburn. A survey was made to Paramatta and Liverpool in 1848, construction was commenced in July, 1853, and the road was opened in September, 1855, between Sydney and Paramatta, 15 miles. A line from New Castle to Maitland was projected in 1853, but it proved a failure. Both of these lines were started by private companies; but as neither was successful, they were transferred to the Government. The first railway opened for traffic in South Australia was the line between Adelaide and Sema-

phore, 7½ miles long, in 1856; the Northern line, in the same colony, was opened to Smithfield, 18¾ miles, in 1857. In 1870, as shown in the table, the total length of railways was 948 miles; no increase was made until 1873, when the total was 1,429 miles, and since then it has increased steadily year by year until it had reached 9,305 miles at the end of 1887. There is now railway communication between the four principal cities of Australia, viz., Sydney, Melbourne, Adelaide, and Brisbane; and from the Queensland coast three trunk lines extend toward the far west.

Considerable information is given respecting the Hawkesbury bridge; but as this bridge has been very fully described in our columns, we omit this part of the report.

The total cost of the construction of the railways is estimated at $416,091,360, and the average cost per mile for several years has been $49,161. The following table shows the average cost per mile in each



Railways in Australia.

colony, the variation being due principally to the condition of the country over which the roads were built, while at some times cheaper material was used than at others. The estimated cost of the railways in Great Britain is given as $243,246 per mile; in Belgium, $177,736 and in France, $134,217.

Average Cost per Mile.

Victoria	$66,349
New South Wales	58,368
Tasmania	37,990
New Zealand	37,190
South Australia	33,371
Queensland	32,181
Western Australia	19,650

According to information furnished to Mr. GRIFFIN by the Commissioner of Railways of New South Wales, the railways were at first constructed on embankments, so as to be above flood levels, which system cost about $38,398 per mile. Surface lines are now built on the principle of following the natural surface of the ground as nearly as possible without appreciably obstructing the flow of flood waters. There were then 600 miles of surface lines in Queensland, and the cost had not exceeded $13,129 per mile, even at a distance of 300 miles from the nearest seaport. The commissioner (then Mr. GOODCHAP) considered the surface lines to be well suited to new countries and to be capable of carrying the traffic for at least 20 years to come. On parts of the Central division and the Northern division, in Queensland, where surface lines have been adopted, the rails and ties are of the same weight as in other parts of the colony, but the amount of ballast is considerably less, averaging about 500 to 700 cu. yds. per mile and not reaching above the bottom of the ties. The surface lines in this colony were introduced by Mr. ROBT. BALLARD, M. Am. Soc. C. E., M. I. C. E.; and from information furnished by Mr. M. THOMSON, A. M. I. C. E., it appears that very few, if any, embankments occur on these lines, and no cuttings except where necessary in order to secure proper grades. The lines cross water-courses or rivers by low level bridges or viaducts (the report says "or fords") providing only sufficient headway for ordinary storm water, but in cases of heavy floods the railways are entirely submerged, "in one case as much as 50 ft." These heavy floods, however, subside quickly, and leave the track clear for traffic. A new system of surface line, designed by Mr. G. PHILLIPS, C. E., is being tried as an experiment. He proposes to keep as close as possible to the natural surface of the ground, and for that purpose he uses steel cross-ties which are merely packed with the surface soil, no ballast being used; the rails are, therefore, only a few inches above the surface of the ground. For the gauge of 3 ft. 6 ins. these ties are 5 ft. long, 8 ins. wide on top, 10 ins. wide at bottom, and 8 ins. deep.

In New South Wales, arched culverts were, until recently, constructed of stone or brick, but lately they have been made of concrete. The same remarks apply to tunnels. Open culverts and bridges up to 26 ft. span are constructed in the first instance with timber superstructures on pile piers; but as occasion requires them to be renewed, they are reconstructed with iron superstructures on brick or iron piers.

Working Expenses and Net Earnings for 1887.

Colony	Working expenses per mile.	Net earnings.	Proportion of working expenses.	Net earnings.	Percentage to capital expended.
	$	$		$	
New South Wales	4,058	3,246,334	69.12	1,810	2.901
Queensland	1,494	1,051,572	68.82	676	2.128
South Australia	1,649	868,568	67.50	798	2.370
Victoria	3,878	4,992,843	38.18	2,788	4.150
Western Australia	1,713	13,106	87.05	180	.700

The working expenses are usually heavy, both on the continent and on the islands of Tasmania and New Zealand. The heavy working expenses in New South Wales are principally due to heavy grades. On the Western Line, which crosses the Blue mountains, the ascent is made by zigzags with grades of 1:30 and curves of 8 chains (528 ft.) radius; on this section of the line there are heavy earthworks, deep cuts, and long tunnels. On the Northern Line, the mountain division has a grade of 1:30 for 3 miles, and on the other divisions the maximum grade is 1:40; on the mountain division there are several tunnels and deep cuts, but after crossing the mountains the road is comparatively easy. In many cases the locomotives on these New South Wales lines had to be assisted by pilot engines, and until the Commissioner of Railways introduced the "consolidation" type of engine from the United States (which engines haul nearly double the loads of the old ones), ordinary passenger trains were frequently drawn by two engines over comparatively level country. In Victoria the maximum grade is 1·40, and the minimum curve 15 chains (990 ft.) radius, while the cuts and tunnels are not extensive.

The working expenses of the roads in New Zealand (and Tasmania) are estimated at $1,484 per mile, but the introduction of American locomotives and rolling-stock is said to be causing a marked reduction in the expenses. For the year ending in March, 1887, the revenue from the New Zealand lines was $5,229,270; expenditures, $3,401,350; tonnage, 1,747,754; passengers, 2,426,407.

Railways in Tasmania.

The growth of the traffic in local production in this colony is shown by the following figures for the years 1879-80 and 1886-87 respectively: wool, 41,895 to 82,963 tons; timber, 149,428 to 175,581 (a decrease from intermediate years; (grain, 240,144 to 345,254 tons (a decrease from intermediate years); minerals, 321,060 to 719,579 tons; live stock, 291,209 to 961,182.

The average annual import of railway material into the several colonies is about 85,000 tons. Of the total amount, the greatest proportion is taken by New South Wales; the imports for that colony in 1887 amounted to 17,181 tons, valued at $1,451,500.

In New South Wales the locomotives are more heavily worked than in any other country except the United States. During 1887, 52 engines made between 30,000 and 40,000 miles, and three made over 40,000. The following table is taken from a report by the Commissioner for Railways:

Average Mileage per Engine.

United States	22,583	Italy	15,118
New South Wales	20,362	Belgium	13,335
India	19,606	Germany	11,870
Great Britain	18,395	Austria	11,842
France	16,798		

The Commissioner of this colony is reported to be in favor of American practice in regard to locomotives and rolling-stock, and is quoted as follows: "If we should apply the principle of constructing our rolling-stock to English practice, we would be unable to earn anything above the cost of working. In the early days of our railways, our rolling stock was designed to English patterns; but in recent years we have not only imported American designs, but we are aiming to construct our stock on principles laid down by the Locomotive Engineers and Car Builders' Association of the United States. We want engines which, while not weighing more than 12 tons on any one pair of wheels, will take 200 tons up a grade of 1 in 40 for 3 miles, and we want vehicles which will admit of two-thirds of this 200 tons being revenue-earning freight. We shall have the sympathy of the railway experts all over the world, who, having heavily graded lines to make, know the importance of the question, and we expect special encouragement from the United States, which, by precept and example, has led the van of progress in this important direction."

The colonies have utterly failed to profit by the experience of other countries in regard to the question of constructing railways with a uniform standard gauge, and the result is that the roads in no two colonies touching one another have the same gauge. In New South Wales the gauge is 4 ft. 8½ ins.; in Victoria, 5 ft. 3 ins. and 3 ft. 6 ins.; and in Queensland, Tasmania, and New Zealand, 3 ft. 6 ins. The Victoria system touches the border of New South Wales in three places, and all freight passing from one colony to the other has to be transferred to other cars, causing expense, delay, and inconvenience. It is a singular fact that although New South Wales, Victoria, and South Australia began the construction of their roads at about the same time, each of these colonies decided upon adopting a different gauge. While there is some economy in constructing light narrow-gauge roads in thinly populated districts, yet experience has shown that in the long run a substantially built road of standard gauge is the best. The policy now recommended is to put down in the first instance cheap lines rather than light ones, using heavy rails, but effecting a saving in ties and bal-

last, so that as traffic increases the lines can be made suitable for it at little additional expense. One of the advantages New South Wales experiences in having the standard gauge is that locomotives and rolling-stock of ordinary type can be easily procured from the United States and Great Britain. The confusion and inconvenience incident to mixed gauges will probably sooner or later lead to the general adoption of a uniform gauge, and it is said that an intercolonial commission is to be appointed for the purpose of settling this vexed question. [The result will probably be the adoption of the 4 ft. 8½ ins. gauge, as the standard, as has been done in this country, the 4 ft. 9 ins. gauge so much used being practically the same. For some years past the companies owning narrow-gauge lines have been gradually widening; the last 5 years the Southern gauge of 5 ft. 3 ins. has been practically abandoned for the standard, in order to facilitate through traffic.—ED. ENG. NEWS.]

The semaphore system of signaling is principally used, every station and junction having home and distant signals. Interlocking systems, similar to those in use in England, are adopted at all stations

Railways in New Zealand.

on the main suburban lines and on the principal country lines. A special arrangement for interlocking is employed at sidings where no one is in charge. When the sidings are not in use, the main line signals indicate that the track is clear and the levers of the apparatus are locked up so that they cannot be tampered with. Conductors requiring to switch onto the side track are provided with a key to unlock the apparatus, and they must then fix all necessary signals before they can open the switch. When the switching is finished the conductor must close and fasten the switch before he can lower the main line signals to show "track clear," and these signals must be lowered before the key can be taken out of the lock of the case which covers the levers. At small sidings, which can conveniently be switched by trains carrying the time staff, fixed signals are used. All sidings in direct communication with the main track are provided with either stop-blocks or safety switches to prevent cars from being moved or blown along, so as to foul the main track. The system of signals is the same in Victoria, South Australia, Queensland, and New South Wales; but interlocking is more extensively used in Victoria and South Australia.

All the railways in Australasia, with the exception of one or two very short lines, are owned by the several colonial governments. These roads were built principally by means of large loans negotiated in England, and their value forms one of the principal assets for the public debt. The policy of giving the control of the railways to the State is very seriously questioned in many quarters. One of the main objections is the amount of patronage controlled, and the liability to use the same for political purposes. Another objection is that under State management the expenditures are greater and the receipts smaller than they would be under the management of private companies; but it is urged by those in favor of State control that the reason why such lines experience a difficulty in making fair returns for the amount of capital invested, is that as soon as a profit is shown, the public insists upon concessions in rates or increased facilities, both of which are practically an amelioration of taxation. The difference between a State and a private railway is explained on the ground that, as traffic develops in one case, the public gets immediate benefit from lower charges and greater facilities, and in the other the shareholders obtain a larger dividend.

The railways in New South Wales are not as remunerative as those of Victoria; but while in the former colony the settlement is scattered, and there are many heavy grades on the mountain divisions, in Victoria the lines have easy grades, for the most part, and run through fairly settled districts. The highest elevation in Victoria is 2,452 ft., and in New South Wales 4,525 ft. In the former, a freight engine can haul loads of 250 tons, while in the latter 90 to 100 tons is considered a fair load. The management of the roads in Victoria was subject to severe criticism, and the complaints became so bitter that in 1883 an act was passed placing the roads under the control of a board of commissioners appointed by the Government. This act went into effect in February, 1884. There are three commissioners, and they hold office for a term of seven years; they are eligible for re-election and cannot be removed except by legislative action. All the lines in the colony are virtually under the control of the board, which is so constituted as to be entirely removed from political influence, and the result is that the lines are said to be worked purely upon a commercial basis. The board is charged with the construction of such new lines as may be authorized by Parliament, as well as with the management of existing lines. A report is made quarterly to the Minister of Railways, and to Parliament in September of every year upon the receipts and expenditures. The chairman receives $14,590 per annum, and the other commissioners $7,299 each. The success of this system has led to the introduction of a bill authorizing the establishment of a similar board in New South Wales, and this measure was expected to be passed with very little opposition.

Sir HENRY PARKES, premier of New South Wales, stated in a recent speech that the railways of that colony would compare favorably with any others in the world. "Considering the solid and permanent character of the great lines of our communication in comparison with some elsewhere, we may come to the reasonable conclusion that, though they have cost us more, they are in reality cheaper." He also gave the following particulars in regard to the longest lines:—In New South Wales: Sidney to Hay, 454 miles; Sydney to Jerilderie, 412 miles; Sydney to Queensland border, 492 miles; Sydney to Narrabri, 352 miles; Sydney to Albury, 387 miles; and Sydney to Bourke, 503 miles. In Victoria: Melbourne to Serviceton, 312 miles. In South Australia: Adelaide to Hergott Springs, 221 miles. In Queensland: Brisbane to Daily Dilla, 410 miles.

The freight charges are considerably higher than in the United States, and the people are constantly clamoring for a reduction of rates. In Victoria, the charges per ton for produce average $1.22 for 50 miles, $2.87 for 100 miles, and $6.52 for 400 miles; the farmers insist that it will not pay them to grow grain unless they get a reduction of fully 50 per cent. on the present rates. In New South Wales, the rates average as follows: coal, in owner's trucks, for distances not exceeding 50 miles, 2 cts. per ton per mile, with a mimimum charge of 48 cts. per ton; for distances over 50 miles, 1⅛ cts. per ton per mile, with a terminal charge of 6cts. per ton, and a minimum charge of $1.03 per ton. Hay can be sent from Bourke to Sydney, 503 miles, at $25.38 per truck; straw and chaff at $22.44 per truck; wool, scoured or greasy, at $24.39 or $21.74 per ton. Wheat is charged at $7.79 per ton for this line, and in truck loads not exceeding 6 tons, at $37.71 per truck; if sent from Sidney to Bourke, 20 per cent. ($4.86) would be added. A rebate of the difference between the local tonnage rates and the through rates plus 42 cts. per ton is allowed from country station to country flour mill (on the up journey) and reconsigned in the shape of flour, bran, etc., to Sydney. Thus, if 100 tons of wheat are consigned during the year from Gerogery to a miller at Goulbourn, 252 miles, and he reconsigns 80 tons of flour in the same period to Sidney, 134 miles, the rebate would amount to $74.37. Cattle and sheep are carried from Hay to Hornebush, 446 miles, at $50.04, and $11.48 per truck respectively. It is stated by the railway department that the charge for carriage should be proportioned to the cost of service, and that it costs more per mile to haul freight 100 miles than 200 miles. This being the case, it seems that shippers sending freight long distances should have the benefit of proportionately decreased rates.

The comparative freedom from accidents is worthy of mention, and for a term of years the lines in South Australia and Queensland were entirely free from accidents. The heaviest loss in any one year on the Victoria lines up to 1885-86 was 38 out of 42,511,014 passengers carried, but in 1886 87 it increased to 50 out of 49,219,867, owing to a serious accident. The most serious accident in New South Wales was in 1885, when 7 persons were killed.

Several transcontinental lines are under construction, in sections. Three trunk lines now start from the eastern coast of Queensland, and run about 500 miles westward. In 1883 an English syndicate offered to connect the western ends of these lines by a transcontinental line with the Gulf of Carpentaria. The proposition to do this on the land grant system did not meet the approval of Parliament, but it is thought that the Government will undertake the work in the near future and will make Normanton the gulf terminus. This city is about 25 miles from the mouth of the Norman river, and is 1,382 miles northwest of Brisbane, according to a recent survey for the overland route. A line is under construction from Cairnes, on the Pacific, westward, and another from Normanton, on the gulf, eastward, both meeting in the Croyden gold fields; by this route, passengers will soon be able to avoid the navigation through Torres straits. The South Australian Government has authorized the construction of a railway to connect Adelaide with Port Darwin, a distance of nearly 2,000 miles, but this ambitious work on the part of a sparsely populated colony is necessarily a matter of time. It is, however, completed or under contract, 800 miles north from Adelaide and 120 miles south from Port Darwin. It is stated that in a few years, probably, passengers from Sydney will reach this Adelaide and Port Darwin transcontinental line at Tarina, by a New South Wales line through Wilcannia, on the Darling river; they will also reach the Queensland continental line via Bourke (higher up the river), thus traveling in an almost straight line from Sydney to Normanton. It has been determined to build a road between Perth, in Western Australia, and Adelaide, in South Australia; this route will place Sydney in direct communication with Perth by way of Silverton, from which latter place there is a line to Fort Pirie on Spencer's gulf.

Mr. PHILLIPS' system of surface lines with steel cross-ties, mentioned in the report, proved so satisfactory that it has been adopted for other lines, and in 1888 he built a line 36 miles long southeast from Normanton towards the Croyden gold fields. The total length of this line will be 94 miles, and it is expected that this system of construction will be adopted for its entire length. The following particulars are taken from a letter from Mr. PHILLIPS:

The country is uniformly even, and the Norman river is the only important river crossed. The first 4 miles are over gravel ridges, when a descent of 1 in 70 for ¼ mile brings the line down to the level of the river flats; the soil is dark clay with an admixture of alluvial sand. This description of country continues to 14 miles, where the river is crossed with a low level timber bridge (principally 20-ft. spans) on a sandstone rock bottom. Thence to Croyden the country is very uniform in character—fine sandy soil, covered with a more or less thick forest of inferior and stunted timber, sometimes dense enough to be called brush or scrub. There is no forest timber of sufficient dimensions in the district available for ties or bridge work, neither is there any stone for ballast, except below the surface, and that is sandstone of an inferior and very soft description. The country is almost uniformly even, except at the 4-mile peg, where there is a cutting of about 5 ft. and an embankment of 5 ft.

Tracklaying was commenced July 7, and completed Dec. 29; about 7 weeks were lost through non-delivery of ties, so that the average rate of progress was 1¾ miles per week of 6 working days. The number of men employed in clearing track 66 ft. wide, grubbing, ploughing, harrowing, and rolling central width of 10 ft., tracklaying, lifting and packing ties, and straightening track, never exceeded 65, with one team of bullocks (12) and one horse. Cost per mile for labor only $630; wages for

laborers, $2 50 per day; gangers, $3.15. Ploughing, harrowing, and rolling cost $75 per mile, which is included in the $630. The total cost was under $15 per lin. ft. The best day's work was .525 mile, and the best week's work a little over 2 miles. No ballast has been provided, and no side or cross-drains cut; the only waterways are at well-defined and water-worn channels. The total timber bridging on the 36 miles is 1,108 lin. ft., and only one box drain has been put in. From 20¼ miles to 36 miles, there is not a single waterway of any description.

The material train never failed to run to the head of the road daily, from the commencement of track-laying, although there were some very heavy thunderstorms with 1 to 2 inches of rainfall in an hour. The track is laid with steel flange rails, 41¼ lbs. per yard, 26 ft. long, fastened to mild steel cross-ties, weighing 84 lbs. each; 11 ties to a rail length. The average gross load of the material train is 100 tons. The locomotive was a six-wheeled engine, of English build. The district passed through is believed to be the softest in wet weather to be found in Australia, but so far no trouble has been experienced with the line. The country is infested with white ants (termites), and ties of the best hard woods of the colony will not last more than 3 years.

The Railway Bridge Failures of 1888.

MR. CHAS. F. STOWELL, Bridge Engineer of the New York State Railroad Commission, has for many years kept as accurate a record as possible of the number and causes of railway bridge failures, and we are again indebted to him for the following detailed record of 1888, and for the tabular summary list of railway bridge accidents in the United States and Canada during the year 1888, with such particulars as it has been possible to ascertain. The list does not cover accidents to trestle bridges or culverts, nor does it include bridges destroyed by the elements without accident to a train. The total casualties to persons included in the list are, 8 killed and 37 injured.

1. *Central Iowa Ry.*— Bridge near Hampton, Ia., reported to have broken under freight train, Jan. 19. Seven cars wrecked. No particulars.

2. *Chicago, St. Paul & Kansas City Ry.*—Bridge over Apple river near Elizabeth, Ill., wrecked in consequence of being struck by derailed freight train Feb. 15. Train thrown from track by broken axle. Several cars wrecked, and one man killed. Bridge was a new, iron, Pratt truss, 180 ft. long.

3. *Chicago, Kansas & Nebraska Ry.* — Freight train went down with bridge near McFarland, Kan., Feb. 19. Ten cars wrecked, one man killed and two injured. Kind of bridge not known. Undermined by freshet.

4. *Southern Pacific R. R.*— Bridge over Hondo creek at Hondo City, Tex., broke under freight train, March 1. Caboose and two stock cars wrecked. Two men killed and two fatally injured. Bridge had been weakened by stick of timber falling from car in preceding train and striking truss. Iron bridge, built by Clarke, Reeves & Co. Classified as "knocked down."

5. *Pennsylvania R. R.*—Bridge at Tyrone, Pa., reported to have broken under freight train, March 20. Several cars wrecked and two men injured. Kind of bridge and cause of accident not ascertained.

6. *Taylor, Bastrop & Houston Ry.*—Bridge at Cedar Hollow, Tex., went down with freight train, March 28. Engine and seven cars wrecked. Six men injured. Wooden bridge, reported to have been knocked down.

7. *Petersburgh R.R.*—Bridge at Stony Creek, Va., broke under freight train, April 20. Bridge undergoing repairs. Kind of bridge unknown.

8. *Burlington & Missouri River R. R.*—Bridge at Alma, Neb., gave way under passenger train. Entire train wrecked. One man killed and one injured. Wooden bridge, supports undermined by freshet.

9. *Gainesville, Henrietta & Western Ry.*—Work train went through bridge near St. Jo, Tex., April 29. One man injured. Kind of bridge not known. Freshet.

10. *Minneapolis, St. Paul & Ste. Marie Ry.*—Freight train wrecked by broken bridge near Bruce, Wis., April 30. Kind of bridge and cause of accident not known.

11. *St. Louis & San Francisco Ry.*—Bridge near Paris, Tex., went down under freight train, May 2. Kind of bridge not known. Freshet.

12. *Milwaukee & Northern R. R.*—Bridge over Michiganne river near Floodwood, Mich., broke under freight train, May 6. Engine and eight cars wrecked and two men killed. Wooden bridge. Freshet.

13. *Richmond & Danville R. R.*—Bridge over dock near ship locks, Richmond, Va., broke under single engine, June 5. Engine wrecked and one man injured. Bridge was a "through" plate girder. Accident caused by reaking of plate conn ecting floor beam to main girder letting engine fall through. Classified as a "square fall."

14. *New York, Lake Erie & Western R. R.*—One span of bridge over east branch of Delaware river at Hancock, N. Y., knocked down in consequence of collision between two freight trains, June 7. Five cars wrecked. Bridge was an iron Post truss, 128 ft. long.

15. *Newport News & Mississippi Valley R. R.*—Bridge over Green river at Rockport, Ky., broke under freight train, June 16. One man killed and three injured. Combination bridge, 220 ft. span, built by the Louisville Bridge & Iron Co. Accident said to have been caused by rotten timbers. Classified as "wooden bridge, square fall."

16. *St. Louis, Keokuk & Northwestern R. R.*—Bridge reported to have fallen under freight train, June 27, in consequence of abutments being weakened by freshet. Three cars wrecked. Location and kind of bridge not known.

17. *New Brunswick Ry.*—Bridge at Magaguadavic broke down under freight train, July 11. Bridge was of steel, 101 ft. 6 ins. span, built by the Dominion Bridge Co. in 1885. It went down in consequence of the truss being struck by projecting wing of a snow plow which was being drawn across.

18. *Denver, Texas & Ft. Worth R. R.*—Engine and baggage car of passenger train went through bridge near Clarendon, Tex., July 15. Kind of bridge not known. Supports had been undermined by freshet.

19. *Atlantic & Pacific R. R.*—Passenger train went through bridge at Laguna, New Mexico, July 24. Engine wrecked and one man injured. Bridge was a wooden one, 100 ft. long. Supports had been washed out by freshets.

20. *Pittsburg & Lake Erie R. R.*—Bridge over the West Youghiogheny river at Connellsville, Pa., broke under freight train, Aug. 2. Engine and one car wrecked and five men injured. Bridge was a low Howe truss about 60 ft. span. Square fall due to rotten timber.

21. *Hannibal & St. Joseph R. R.*—Bridge at Randolph, Mo., went down under freight train, Aug. 7. Engine and 15 cars wrecked. Bridge was a wooden one about 60 ft. long and gave way in consequence of pile supports being washed out by heavy rain.

22. *Canadian Pacific Ry.*—Bridge over Credit river at Streetsville, Ont., broke under freight train, Aug. 27. Bridge was a Howe truss, 100 ft. span. Accident said to be due partly to old age and partly the removal of some bolts in order to commence repairs. Classified as "undergoing repairs."

23. *Oregon Ry. & Nav. Co.*—Bridge near La Grande, Ore., struck by runaway train with derailed truck and knocked down, Aug. 27. ENGINEERING NEWS is authority for the above statement. No further particulars obtainable.

24. *Missouri Pacific Ry.*—Freight train went through bridge at Burleson, Tex., Sept. 11. Two men injured. No particulars.

25. *Eutawville Ry.*—Bridge over the Santee river, near Vance, S. C., went down under freight train, Sept. 14. Bridge was a wooden one, 150-ft. span, resting on pile foundations which were undermined by stream.

26. *Oregon Ry. & Nav. Co.*—Freight train broke through burning bridge at Mosier, Ore., Sept. 14. Engine and six cars wrecked and one man injured.

27. *Northern Pacific R. R.*—Bridge near Sprague, Wash. Ty., broke under freight train. One man injured. Kind of bridge and cause of accident not known.

28. *Gulf, Colorado & Santa Fé Ry.*—Bridge near Bellville, Tex., broke under freight train, Sept. 19. Several cars wrecked. Bridge was a wooden one, 140 ft. long. Cause of accident not known.

29. *St. Louis, Iron Mountain & Southern Ry.*—Bridge over the St. Francois river near Fredericktown, Mo., gave way under freight train, Sept. 29. Seven cars wrecked. The bridge was a new, iron one, 104 ft. span, still on the falsework but reported to have been very nearly completed. "It would have been finished in six hours." Classified under the head of "undergoing repairs."

30. *Missouri Pacific Ry.*—(St. Louis, Ft. Scott & Wichita R. R.)—Bridge over Walnut creek near El Dorado, Kan., broke under double-headed stock train, Nov. 15. One engine and ten cars wrecked and two men injured. Bridge was a Howe truss. Railroad company reported it to have been knocked down by derailed car, but train men who went down with it say they know nothing of derailment. It is classified as a "square fall."

31. *Denver, Texas & Ft. Worth R. R.*—Freight train broke through bridge near Rhome, Tex., Nov. 18. Five cars wrecked and two men injured. Wooden bridge, 160 ft. long. Cause of accident not known.

32. *St. Louis, Arkansas & Texas Ry.* — Baggage and smoking-car of passenger train went through floor of bridge near Ft. Worth, Tex., Dec. 25. Five persons injured. Wooden bridge. Classified as "square fall."

A number of accidents were reported during the year as "bridge accidents" which on investigation proved not to be such. Thus in September it was reported that some runaway flat cars loaded with rails knocked down a bridge on the Wickes Branch of the Northern Pacific railroad near Clancy, Mont. An accident of the sort did happen, but the bridge was not injured. Again it was reported that the new steel bridge of the Baltimore & Ohio railroad over the canal at Zanesville, O., was struck and wrecked on Dec. 20. This bridge is a new, plate girder, "bob-tail" draw, and was not quite finished. On the date mentioned a freight train ran into the draw when partly open. It struck and slightly damaged one corner of the bridge and knocked off a temporary counter-weight on the short arm, letting that end of the bridge tip up. The bridge was not seriously damaged. It is possible that some of the other accidents of which particulars could not be obtained might, on investigation, prove to be erroneously reported.

Below is a classified list of bridge accidents for ten years up to and including 1888. The numbers reported for 1879 and 1880 are probably much too low:

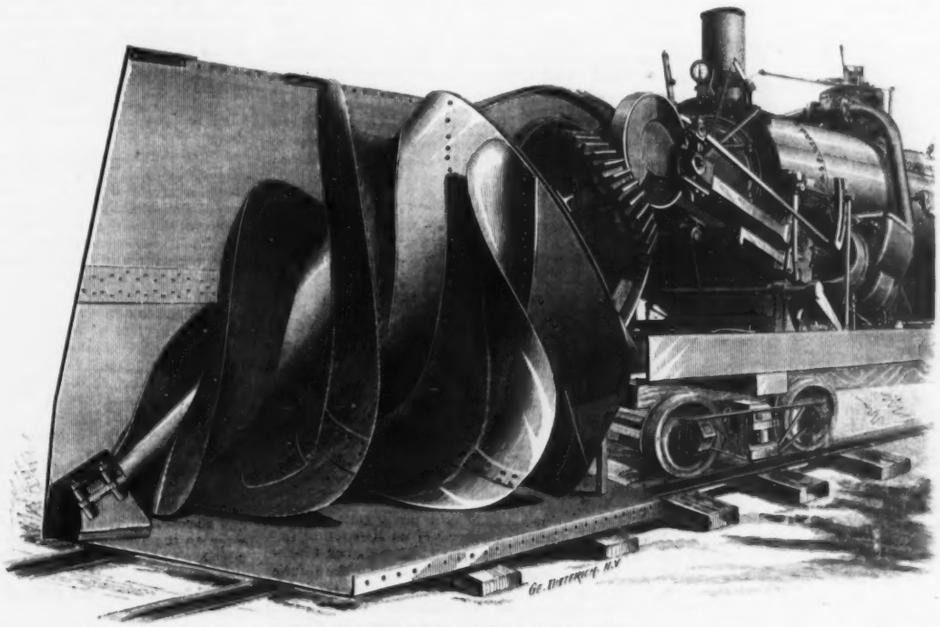
| Year | Cause of Accident and Kind of Bridge. | | |

Jull's Centrifugal Snow Excavator.

The accompanying illustration shows the latest effort of Mr. ORANGE JULL, of Orangeville, Canada, to improve upon his own very meritorious and successful invention, the rotary snow plow, which has now become better known, however, as the Leslie plow, from Mr. J. S. LESLIE, the president of the company which purchased Mr. JULL'S rights in his original invention. That plow, as our readers will remember from the full descriptions which we have at various times published, works upon an entirely different principle from the one now illustrated, as well as from all previous plows, as follows: A knife-wheel, about 9-ft. in diameter, revolves in front at a high velocity, transversely to the track, provided with 4 to 8 oblique knives, which, as the "plow" continually advances from the push of a locomotive behind, slices off the snow in what is practically a continuous sheet, driving it backward into a closed circular box behind. In that box a fan-wheel revolves with the same velocity as the knife-wheel, but in the opposite direction. This fan-wheel catches the snow as delivered into the box, generates a great centrifugal force in it, and throws it out through a spout at the top in a continuous stream, which is sometimes projected as far as 250 to 300 ft. from the track. By an ingenious but somewhat complicated device the inclination of the knives and the direction of motion and of discharge of the whole machine are reversed when desired,—a very necessary provision, because of variations of wind and slope of surface. These machines have usually had 17 x 22 in. cylinders, and boilers of about the size and proportion of ordinary locomotive boilers for cylinders of that size. The weight of the first machines was about 45 tons (of 2,000 lbs.) and the length of the whole plow-car, 28 ft. 4 ins.; but these dimensions have latterly been increased to about 34 ft. and 55 tons.

The new centrifugal machine which we illustrate works upon an entirely different principle, except in this, that the end of both "plows" (as they must for convenience be called) is to generate a high centrifugal force in the snow by the exertion of great power, and throw it out in a solid stream to a considerable distance from the track. The original rotary separates this process into two parts, however, —knives to cut the snow and throw it backward on the fans, and a fan-wheel used purely to generate centrifugal force. The new centrifugal plow combines these two processes in one: the front of the plow is entirely open (the two sides of the case removed being less prominent than those shown), and in this square box works—entirely exposed to view and to contact with the snow—an immense oblique gimlet-point augur, revolving at high velocity, which at one and the same operation catches the snow *in situ* after the lower plate has cut under it, pushes it rapidly backward, and so cuts it apart, and at the same time *gradually* generates the required centrifugal force. The screw always turns in the same direction, and the direction of the jet of discharge is regulated merely by the openings in the top case, which is shown removed in order to allow the mechanism to be seen more clearly, but which is a very simple affair, as will more fully appear in a following cut.

It will be apparent at once that this is a very much simpler process mechanically. All that is necessary is to give a quick revolving motion of 180 to 300 revolutions per minute to the cone, and that is the end of the process. There is no double direction of revolution, no reversion of knives, and no closed box to hold snow back of the mechanism which first attacks it. It therefore seems reasonable to hope that, as is claimed by the inventor of both devices, this may prove simpler, cheaper, and more effective in practical work.



The Jull Centrifugal Snow Excavator.
General View of Mechanism, two Sides of Plow-Shell Removed.

The cone itself is a very heavy affair, weighing alone some 6 tons. It is built entirely of ⅝-in. steel, 8 ft. in diameter at the base, and, as will readily be believed, the first one was an expensive and troublesome affair to get just right, since it consists entirely of warped surfaces for which formers had to be made. It is expected, however, by the use of these formers to reduce the cost greatly. The interior of the blades are of somewhat less than semicircular section, and they are reinforced on the outside by a quadrant brace-plate, also of ⅝-in steel, giving the section of the blade an inverted Λ form, except that the lines are curved and not straight. The blades are 2 ft. deep at the base, tapering down to almost nothing at the point.

The engine driving the cone consists of two 18 x 24 in. cylinders, with a boiler of 800 H. P., or somewhat larger than the usual locomotive boiler for cylinders of that size, which it closely resembles. The boiler has 230 2-in. tubes, but as the details of its design have no necessary connection with the plow, and may be varied at pleasure, fuller description is now unnecessary. The engines make 320 revolutions to the plow's 300, and are provided with the usual link reversing gear, although reversing is not required in regular work. In case of clogging of the machine from an exceptional cause, the reversion may be convenient for clearing it, but in any case all working parts are readily accessible.

The quadrangular surrounding plow-shell is also built of ⅝-in. steel, suitably braced, and is 9 ft. wide at the rails, expanding to 10 ft. in the first 11 ins. of rise. The height of hood is 10 ft. and the extreme height of the car 13 ft. 6 ins. The entire frame of the car is of iron or steel, and the length of the whole apparatus 42 ft. The weight of cone, hood, and connecting mechanism forward of the front trucks is about 20 tons, and of the whole car complete, 65 tons. An ordinary locomotive tender is attached behind to supply the plow, and the whole pushed by a locomotive from behind.

A trial of this new and powerful machine was made in the yards of the Rome, Watertown & Ogdensburg Ry., March 11, in the presence of a large number of representative railroad men, and was certainly very successful, especially in view of the fact that it was only the third time that the machine had ever turned a wheel. The snow was heavily drifted and ranged from 15 ins. to 10 ft. in depth. The rails were likewise covered with a heavy coating of ice. The plow, when working at 180 revolutions, threw a column of snow about 4 ft. in diameter a distance of 60 ft. It was stopped three times in clearing 720 ft. owing to lack of flangers, but including time so lost took only 7 minutes in clearing 720 ft. of snow averaging about 7 ft. deep, varying widely as above stated. It was estimated at the time by Asst.-Gen. Man. BOWEN that it would have taken 100 men a day to do the same work. The machine was not run at full speed from prudential reasons, it being so near the end of the season that the opportunity for further tests would have been few, had any breakdown chanced to occur. No sign of trouble of any kind occurred, and it is reasonably claimed that the full speed of 300 revolutions might just as well have been used, although 180 is regarded as a sufficient ordinary working speed.

After this test a kind of comparative exhibition of the original rotary plow was held in another part of the yard, the result of which is thus described in the Oswego *Palladium*:

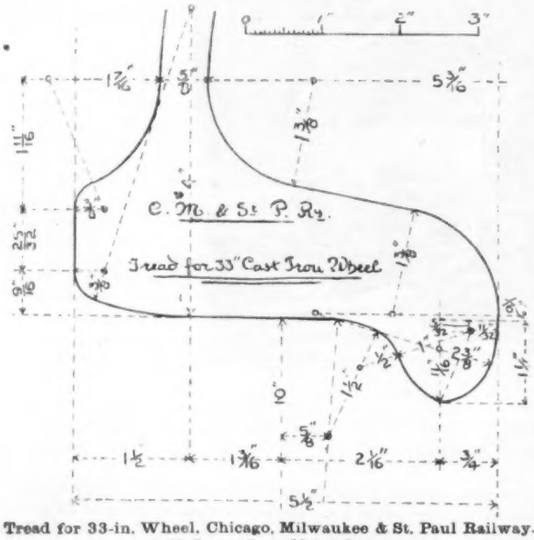
> When the visitors reached the scene, the plows had just passed through a huge drift at least 11 ft. high. Two engines were coupled on, and the machine was set to work. In 11 minutes, by taking 12 starts, it cleared 333 ft. of track, the average depth of which was 5 ft., the minimum depth 2 ft., 6 ins., and the maximum depth 8 ft. Twice the fan was stopped working, and it seemed to bury itself in the snow, but only for a short time, for the revolving fans soon cut the snow away. From the tests of the two machines, the opinion was expressed that the working of the centrifugal was the best and that it would probably have done even better work on the east side cut than on the west side. Both, however, are wonderful machines, and a road equipped with either would not apparently need to be blockaded long. The rotary plows have been out for five years and 26 of them are employed on roads in the United States. This is the first of the centrifugal machines ever made.

It would not be fair to found any definite comparative conclusions on a single test of this nature; but in view of the fact that this was the first machine ever built, it certainly made a good record, and it would seem to be intrinsically the simpler and more promising type. Either one of them is a vast advance on any form of plow that before existed, all of which rely on merely pushing the snow to one side or on its mechanical removal on cars, and are both inefficient and highly dangerous, especially when six or seven engines are coupled together and used as a battering ram. This barbarous and, one may fairly say, murderous system of fighting snow is already discredited and likely to go out completely.

The machine illustrated is manufactured by the Jull Manufacturing Co., GEO. H. HOBART, President, 139 Montague St., Brooklyn.

Experimental Wheel-Tread, C. M. & St. P. Ry.

The proposed wheel section which we illustrate is one which has been undergoing test on the Chicago, Milwaukee & St. Paul Railway since 1885, and with very gratifying results; so much so that we understand it to be under consideration whether it will not be expedient to adopt it as a standard of the road. The notable feature of it is the compound fillet radius, by which it is endeavored to ensure that the flange shall *not* come into contact with the side of the rail. Whether the compound radius of 1⅛ in. and ⅛ in. will really answer this purpose any better than, or as well as, a single fillet radius of ⅜-in. or 1-in., we are not entirely clear, but that it is a decidedly better section than the present M. C. B. Standard, we have no doubt. The purpose in view in designing the section is more particularly expressed in a letter of Mr. J. N. BARR, Supt. M. P., C. M. & St. P. Ry., as follows:*



Tread for 33-in. Wheel, Chicago, Milwaukee & St. Paul Railway.
J. N. BARR, *Supt. Motive Power.*

REPORT ON RAILWAY WHEELS AND RAILS.

In my opinion, this matter of form of flanges is one of great importance in a pecuniary sense, and one which should be thoroughly and practically investigated. Speaking theoretically, my idea has been that a correspondence between the fillet in the wheel-flange and the head of the rail would be the correct construction if the wheels should slide upon the rail. This is certainly true for sliding pieces; but in the case of rolling pieces, it can well be doubted if the reasoning on sliding pieces will apply. In my opinion, a close correspondence between the fillet at flange of wheel and the head of the rail would certainly produce a grinding action, which would not only wear the flange and rail unduly, but which would also have an influence on the number of cars which a locomotive could haul.

Looking at the matter in this way, it appears to me that, if a form of tread and flange could be designed that would have a tendency to guide the wheel along the track and prevent that flange coming in contact with the rail at all, improved results might be looked for both as to flange-wear and traction. With this object in view, I designed the form of tread and flange shown in the accompanying blue-print, dated June 30, 1885. The center of the rail is located on the line marked 10". Toward the outside rim of the wheel the tread, for a distance of 1⅛ ins. is perfectly cylindrical. Toward the flange the section of the tread increases in diameter for a distance of ⅝-in. with a radius of 10 ins. From this point a radius of 1½ ins. is used in forming the outline of the tread section, and finally a curve of ½-in. radius extends into the reverse curve of 1-in. radius, which continues to the point of the flange.

It is not possible to say at the present writing whether the proportions given are the best. It may be that the radius used could be still decreased to advantage. It will readily be seen, however, from an inspection of the drawing, that if the rise from the center of the tread to the body of the flange be too much exaggerated, there will be a tendency to hold the wheel to one point with reference to the rail, and to wear a groove the width of the head of the rail into the tread of the wheel, instead of distributing the wear over the entire surface of the tread. This, of course, would shorten the life of the wheel. Having no data, however, for guidance, it was determined to test the tread in the form shown, and accordingly two chills were made, and two wheels were cast in them daily. These wheels were placed in service as made, and a recent review of mileage results is shown in the following statement:

WHEELS WORN OUT.

Defects.	*No. of Wheels.*	*Average Mileage.*
Hollow at flange	8	65,471
Hollow from flange	5	83,237
Worn flat	1	60,013
Worn tread	3	78,239
Shelled out	1	12,780
Cracked brackets	4	19,348

WHEELS DRAWN, GOOD FOR FURTHER SERVICE.

Defects	*No. of Wheels.*	*Average Mileage.*
Hollow at flange	4	61,738
Hollow from flange	10	57,693
Worn tread	4	72,480

[Worn flanges, none; "hollow at flange" means hollow in tread at flange, not a sharp or worn flange.]

In the matter now under consideration the wheels condemned on account of the defects "shelled out" and "cracked brackets" play no part. Investigating the results given above with a view of determining whether the rise from the center of the tread to the body of the flange be too abrupt, it will be observed that there are three wheels condemned on account of worn tread, and that the average mileage, 78,239, is well up to the general average of the worn-out wheels. It may be inferred from this that the rise to the flange is not so great as to confine the wear to a narrow groove in the center of the tread and produce an injurious influence on the mileage.

It should be borne in mind that the failures classified under the head of "worn tread," are such that the wear is either at the middle of the tread in a narrow groove or is uniformly distributed over the tread, as distinguished from "hollow at flange." The term "hollow at flange" indicates that the principal amount of wear is close to the flange, the outside of the tread being but little worn, and the flange also being but slightly affected; and the term "hollow from flange" indicates that the principal amount of wear is on the outside of the tread, that portion of the tread adjacent to the flange being but little worn, and the flange itself being often not worn at all.

The proportion of wheels worn hollow at flange, slight in number, goes to show that there is considerable freedom of play in the wheel across the rail, and that the rise or form of fillet at the flange is not so great as to prevent the wheels, under certain circumstances, from breaking and wearing close to the flange. At the same time, it should be observed that there is not a single wheel condemned on account of worn flange. I have made it a point to personally inspect these wheels as they were returned from service, and in no case was there a sharp or worn flange, and the general appearance of the tread gave evidence that the flange in sight had but little to do with guiding the wheel on the rail. For purposes of comparison it may be stated that during 1886 10 per cent. of the worn-out wheels arrived from passenger cars were scrapped on account of worn flanges, and the average mileage of these wheels was 70,606 miles.

It would not be safe to make any extended deductions from the limited number of wheels with fillet as described, of which record has been obtained; but the results are so encouraging that it has been determined to extend the use of this form of tread, and in the course of about two years we shall doubtless have sufficient figures and data to come to a definite conclusion.

I am, however, decidedly of the opinion, not only from the mileage figures given, but also from the appearance of these wheels after service, that the best results as to flange wear will be obtained by designing the tread and fillet so as to guide the wheel without bringing the flange into contact with the rail.

With regard to radius of curvature for edge of rail I have not given the matter much attention, and have no data that would throw any light upon this point.

With regard to the effect of quality of wheels on the proportion of sharp flanges, I have not got my data in such shape as to present figures, and it is a matter that could not be very well presented in such a way. The following, however, are my deductions from our wheel records and observations.

First.—It is the exception to find two wheels on the same axle both wheels having worn flanges.

Second.—The conclusion from this is, that curves have little to do with flange wear.

Third.—The trucks with which I have had experience have little to do with flange wear. This conclusion is arrived at by reversing wheels in the truck when one of the wheels begins to show flange wear, so that the worn flange occupies the position of the good flange and vice versa. In nearly every case the wheel with the worn flange continues to wear the flange.

Fourth.—If wheels differing in size are mounted on the same axle, the small wheel almost invariably wears the flange.

Fifth.—Difference in the wearing quality of two wheels on the same axle is the main, almost exclusive, cause of flange wear, the wheel which wears most rapidly being forced against the flange; presupposing, of course, fairly good workmanship in trucks and mounting of wheels. If a make of wheels is uniformly poor, there will be less liability to flange wear than if some have very good wearing qualities with the rest poor.

As to the comparative mileage of wheels removed for worn flanges and for other causes, the mileage under passenger equipment of wheels condemned on account of worn flange, is generally a little greater than the average mileage of worn-out wheels (exclusive of sliding) condemned for other defects. This assertion is made from a large amount of data of a definite character which I have no time to present.

As to comparative numbers of sharp flanges among steel-tired and cast wheels it is difficult to make comparisons, as my practice has been to remove and true the wheels up as soon as one gave definite signs of wearing the flange, and also to remove such wheels and remate, placing two wheels showing signs of flange wear on the same axle, and also mating together those wheels which have preserved their flanges intact. In this way wheels of the same wearing quality are gradually mated together and the general average mileage increased.

This letter was written about eighteen months ago, but experience to date has confirmed its conclusions, which are certainly worthy of study.

*Letter to Secretary of Committee of the American Society of Civil Engineers on Proper Relation to each other of the Sections of Railway Wheels and Rails, published on page 52, Report of that committee. We reproduce the letter slightly abbreviated.

The Vivarttas System of Garbage Cremation.

This system of cremating garbage and refuse aims at the complete combustion of the gases evolved during the cremation as well as the complete consumption of the garbage and other matter Experiments made in New York showed that while the solid matter could be consumed and reduced to ashes with comparatively little air, the resulting gases could only be rendered innocuous by high temperature, plenty of oxygen, and plenty of time. When the furnace was worked with reference to the cubic capacity of its combustion chamber, the work could be carried on with regularity and economy. The garbage in this case had been passed through water, and was only dried in the crematory, but the heat was so great that the matter was thoroughly consumed. The crematory is fitted with drying chambers in which the garbage is first placed, and where it is dried by the heat from the combustion chamber; when dried, a door is opened, allowing it to drop into the combustion chamber; and in this way the fire is not checked by dumping wet material upon it. The blast is heated in flues around the side of the furnace, and can be turned into the furnace or the combustion chamber and either beneath the garbage or at the center. The combustion of the gases is effected in the upper part of the combustion chamber, and they are further decomposed in the downtake of the chamber, thus obviating the necessity for high chimneys. With a hearth having a pitch sufficient to carry off the slag, and with the coal fire on a separate grate, no trouble was experienced with clogging. The method recommended is to use a group of furnaces, with a number of grates and drying chambers, so as to regulate the process in accordance with the varying

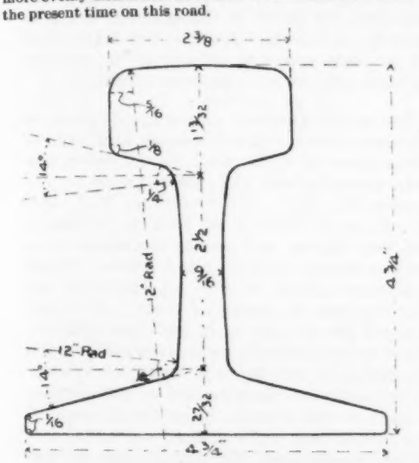
amount of garbage at different times, and also to maintain a uniform heat and steady operation by attending to the fires and feeding the combustion chambers from the drying chambers in regular turns. It is said to be economical to construct the crematories with a capacity to consume 1 cu. yd. of garbage per minute, or 600 cu. yds per day of 10 hours. This system has been adopted by the Seaboard Sanitary Garbage Cremating & Refuse Utilizing Co.; Secretary, SEYMOUR G. SMITH, Plainfield, N. J.

Chicago & Northwestern Rail Section.

We are indebted to Mr. JOHN E. BLUNT, Chief Engineer of the Chicago & Northwestern Railway, for the accompanying section, showing the 1889 standard of that road. Mr. BLUNT says in an accompanying note:

I enclose you a print of the standard Rail Section adopted by this company for use on our main lines.

You will see by the following table that the metal is more evenly distributed in this rail than in those in use at the present time on this road.



Standard 1889 Section, Chicago & Northwestern Railway. JOHN E. BLUNT, *Engineer.*
[Half full size.]

C. & N. W. Co's. Rails.		Head		Web		Flange		Total		St'l
Date	Wt.	Per Cent.	Area	Per Cent.	Area	Per Cent.	Area	Per Cent.	Area	Wt.
1889	72	40.68	2.88	22.74	1.61	36.58	2.59	100.	7.08	72.2
1887	72	47.47	3.38	18.90	1.35	33.57	2.39	100.	7.12	72.6
1883	65	47.44	3.10	18.77	1.23	33.79	2.21	100.	6.54	67.1
1880	60	47.61	2.81	20.43	1.21	32.06	1.90	100.	5.92	60.4
1879	50	46.96	2.31	16.44	0.81	36.60	1.80	100.	4.92	50.2

The section is notable for the peculiarities mentioned in this letter, and seems to us one calculated to render good service. The thick web, heavy base, and comparatively small head are likely to give a much more homogeneous texture to the metal, by enabling it all to be rolled at a nearly uniform temperature. We should be disposed to prefer 1-4 in. to 5-16 in. corner radius; but the difference, after all, is not great. So far as form can control it, the rail ought to render good service.

Points to be Considered in Designing a Pumping Engine.*

BY WM. J. MCALPINE, M. AM. SOC. C. E., M. INST. C. E.

Two parts of the machine resemble each other, the steam cylinder, its pistons, valves, and openings furnishing the power, and the water pumps with similar pistons, valves, and openings through which the work is performed.

We dismiss rotary pumps from consideration, and refer to reciprocating single-acting lift pumps, as the most simple form of this part of the machine.

Steam, 1,700 times lighter than water, and very elastic, passes through the valves and passages of the steam engine with comparatively very small friction; the water, on the other hand, comparatively ponderous, and though mobile entirely inelastic, is usually forced through valves, channels, and pipes in the same manner as the steam.

At every change of direction or form of the volume of the moving water, considerable friction is produced, and in those reciprocating double-acting pumps where the motion of the water is reversed, that portion of the power of the engine which has been taken up in producing motion in the ponderous fluid is not only destroyed on the return stroke, but consumes an equal amount of the power itself to destroy this momentum.

To determine the most appropriate velocity for the water through the pump passages, and forcing mains, I take the old Cornish engine as the best example afforded us.

In this case the engine may be considered in two parts. The power of the steam is first used to elevate a determined weight, and then the steam-engine part of the engine may be considered as detached; and the weight, descending by its gravity, forces up a corresponding weight of water, commencing with little motion which increases as the weight descends, and the upward motion of the water acquires velocity, until, when the engine is properly loaded, the two become nearly equal. This would be the perfection of motion in a water pump, except that at the end of the stroke the velocity becomes too great, and this is usually checked by an air cushion at the bottom.

In the test working of these old Cornish engines, the average speed of the water piston or plunger has been found to be 125 ft. per minute, which we may consider as about the limit of the velocity of the water piston. (The friction of the water and its loss from change of direction increases as the square of the velocity, and hence it may be said that the slowest motion requires the least power; but there are other considerations, in the size of the pumps, etc., which prevent us from reducing the speed below the above limit, and in some cases we may find it advisable to increase it to 150 ft. per minute.)

The speed of the steam piston used to be given at about 250 ft. per minute, but in modern practice this speed is, when advisable, increased greatly.

For the present consideration we will assume a steam piston speed of twice that of the water. All direct-acting water engines which require the speed of the steam and water engines to be the same are objectionable, because the one will be too slow and the other too fast.

The simplest intervention to give these two pistons each their proper speed, is by means of the ordinary working beam, where the steam piston is attached to the outer extremity, and the pump piston at just such distance towards the main center as will give each of them their appropriate speed.

There is one loss inevitable in this machine, but common to all pumps, in the resistance which the pump buckets and pistons meet with on the return stroke through the ascending column of water through the pump; and this again renders it advisable to keep the speed of the pump piston as low as possible.

In an engine of this character, with water pumps on each side of the main center, there is a constant load of water on one or the other pump piston, equal to area of piston by the elevation of the water including a constriction head equal to the friction of the water through the force main. For that reason steam cannot be used expansively for more than two-thirds the length of the stroke, as it must at all times be equal to the load of water in the pumps less its momentive force flowing upwards.

Thus arranged, the steam is let on to the piston at its maximum pressure, and commences the stroke in slowly overcoming the inertia of the still column of water, and continues through one-third of the stroke with the full pressure, thus putting into the ascending column of water a sufficient power, with that of the other aids, to balance the weight of the water at the end of the stroke where the steam pressure has fallen to one-third its original amount.

The moving parts of the machine, namely, the working beam, pistons, piston rods, etc., in like manner acquire a momentum which aids the waning power of the expanded steam through the last end of the stroke. A fly-wheel will also aid this operation, but it would be advisable to provide some other method of carrying the engine over her centers.

Such an arranged engine would not favorably strike the eye of a good mechanic unfamiliar with its mode of operating, as, when the expansion valves are properly adjusted, its motion will be very irregular through the different parts of the stroke, namely, beginning very slowly, increasing in speed to the third part of the stroke, and then diminishing almost to a standstill at the end of the stroke.

The most simple valves should be used, namely, those which least divide the column of water and have the least frictional surface.

The delivery of water from the top of the pump should be on a curve of several feet radius, and all other changes in the direction of the force main should be in large radii.

An engine thus arranged would have to encounter the smallest amount of friction of any of its parts and be without concussion.

It would therefore be of cheap construction, maintenance, and a higher duty than any pumping engine in use.

[These anticipations, we may note, were realized in construction.—ED.]

[*Mr. MCALPINE writes us in regard to these interesting notes:

"I lately came across some notes which I had put down in my note-book nearly 40 years ago. I still hold to the principles which I then laid down, on which I subsequently constructed several large pumping engines which gave excellent results. These were the pumping engines at the U. S. Dry Dock, Brooklyn, two at the Chicago Water-Works, and one at the New Bedford Water-Works. I think they would still be of service to those who are engaged in the examination of this subject."]

The Abolition of Grade-Crossings in Massachusetts.

The following bill for abolishing grade-crossings in Massachusetts is now before the Railroad Committee of the Legislature:

Sec. 1. Sections 121, 130, 131, 132, 133, and 134 of chapter 112 of the Public Statutes are repealed and the following sections substituted therefor:

Sec. 129. When the directors of a railroad company, or the persons authorized to lay out town ways in a city or town, desire to abolish an existing grade-crossing of the railroad and a public way, or to prevent a new one being made, and shall petition the railroad commissioners thereto, said commissioners shall, after due notice hear all parties interested and pass an order prescribing the manner in which such crossing by a bridge and approaches thereto shall be made, and cause a copy of such order to be recorded in the registry of deeds for the county or counties in which said crossings in whole or in part lies.

Sec. 130. The said railroad company shall forthwith proceed to make such bridge, its abutments and supports, and such parts of the approaches thereto, if any, as are within its location; and the city or town shall proceed to make such parts of the approaches thereto, if any, as are outside of the said location.

Sec. 131. The city or town shall pay all damages sustained by any person in his property by the carrying out of said order, and if the parties cannot agree as to such damages, the same shall be determined by a jury at the bar of the superior court for the county in which such crossing in whole or in part lies, in the manner in which damages for the laying out of ways in said city or town are determined, on petition filed by either party within one year after the filing of said order.

Sec. 132. All expenses of carrying out said order, including the damages paid under the preceding section, shall be borne, one-half by the railroad company and one-half by the cities or towns benefited by the way, to be determined by the directors of the railroad company and the board of officers authorized to lay out town ways in the cities and towns benefited, and if they cannot agree, the parties who, and the proportions in which, they shall pay shall be determined by three commissioners appointed by any justice of the superior court sitting in equity for the county in which the crossing in whole or in part lies, on the petition of any party interested, and said determination, when accepted by said court, shall be final, and a decree shall be entered by the court in accordance therewith.

Sec. 133.—After the said order of the railroad commissioners has been carried out, the railroad company shall maintain, at its own expense, the bridge, its abutments and supports, and such parts of the approaches to the bridge, if any, as lie within the limits of its location; and the city or town shall maintain at its own expense such parts of the approaches to the bridge, if any, as lie outside of the railroad location.

Sec. 134.—Any court sitting in equity in any county may enforce the order of said railroad commissioners, and the findings, judgments and decrees of court made under authority of this act.

THE OPENING OF THE OKLAHOMA TERRITORY to settlement is the signal for a rapid extension of the "Rock Island" and "Frisco" lines to the heart of the Territory. The mileage to be built, however, is not large.

GENERAL MANAGER WHITMAN of the Chicago and Northwestern has addressed a circular letter to the managers of other Western systems suggesting that a conference be held with a view to a more economical management of their properties. He thinks that the several companies should endeavor by uniform action to eliminate from their service some of the expensive features that have gradually come into existence as an outgrowth of sharp competition.

ENGINEERING NEWS
AND
AMERICAN RAILWAY JOURNAL

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D. McN. STAUFFER, A. M. WELLINGTON.
EDITORS.
GEO. H. FROST. - - - - - BUSINESS MANAGER.

Subscription. – UNITED STATES AND CANADA, $5.00 *per Year;* $2.50 *for Six Months;* $1.50 *for Three Months; Single Copies,* 12 *cents.* FOREIGN COUNTRIES, $6.56 *per Year, or* 3 *cents per number additional.*

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Drawings for publication *should preferably be in plain black and white, considerably larger than they are expected to appear, with letters and figures in pencil only, all lines clean and bold.*

Coming Technical Meetings.

Engineers' Club of Kansas City, Mo.—Regular meeting, April 1 "Pollution, with Especial Reference to Water Supply and Sewerage," Kenneth Allen. Discussion on "Strengthening Iron Railway Bridges." Secy., Kenneth Allen, 310 Baird Building.

American Society of Civil Engineers, New York.—Regular meeting, April 3. Secy., John Bogart, 127 E. 23d St.

Engineers' Club of St. Louis, Mo.—Regular meeting, April 3. "The Boiler for Use at Coal Mines." Louis Stockett; "Steam Plants for Electrical Service," W. H. Bryan. Secy., Wm. H. Bryan, 709 Market St.

Western Society of Engineers, Chicago, Ill.—Regular meeting, April 2. Secy., John W. Weston, Gaff Building.

Engineers' Club, Philadelphia, Pa.—Regular meeting, April 6. Secy., Howard Murphy, 1122 Girard St.

Association of Civil Engineers, Dallas, Tex.—Regular meeting, April 6. Secy., E. K. Smoot, 15 North Jefferson St.

Civil Engineers' Club of Cleveland, O.—Regular meeting April 9 Report on Applied Science. Secy., James Ritchie, Case Library Rooms.

New England Railway Club, Boston, Mass.—Regular meeting, April 10. Boston & Albany passenger station.

Engineers' Society of Western Pennsylvania, Pittsburg, Pa.—Regular meeting, April 16. Secy., S. M. Wickersham, Penn Bldg.

Boston Society of Civil Engineers, Boston, Mass.—Regular meeting, April 17. Secy., S. E. Tinkham, City Hall.

New York Railway Club.—Next meeting, April 18. Rooms, 113 Liberty St., New York City.

Association of North American Railroad Superintendents.—Spring meeting, Apr. 18 at 46 Bond St., New York City. Annual election of officers. Secy., C. A. Hammond, 380 Atlantic Ave., Boston, Mass.

American Society of Mechanical Engineers.—The annual meeting will be held at Erie, Pa., May 14, 15 and 16. Secy., F. J. Hutton, 240 Broadway, New York City.

WE are glad to note, as set forth in another column, that at least one society of civil engineers in this country has earnestly set about the improvement of our country roads, and, as a necessary first step, has already framed a bill which is now before the Pennsylvania Legislature. This is a subject that should, and doubtless does in some degree, interest every civil engineer in the United States; and it is highly proper that engineers as a class should take the initiative step in each State in the correction of the present wasteful and utterly inefficient conduct of affairs in connection with our country roads. The first requisite is the abolition of existing laws which either legalize improper methods or are inoperative owing to faulty construction and impossible requirements. In the work of framing new and effective laws the knowledge and practical experience of the engineer is especially useful, as he is the man who is more likely than any other to know what can and what cannot be done, and to avoid the pitfalls which might otherwise render legislation, fair to read of and theoretically perfect, utterly useless in practice.

THE brief sketch of the bill presented to the Pennsylvania Legislature by the Engineers' Society of Western Pennsylvania appears to be a sensible and perfectly practical solution of a problem usually deemed complicated by law makers. It simply converts into hard cash the taxes now mainly paid in so-called work; and, without increasing taxation, it puts the expenditure of this sum into the hands of a competent engineer, and executes the necessary work by contract. There is no hardship in this to the tax-paying community, while there certainly is a prospect of getting much more than formerly for the money expended. The only possible objection to it, from the farmer's standpoint, is that it puts an effectual stop to his time-honored but vicious practice of defrauding both himself and his neighbors by substituting bad work for good money,—money that in proper hands and under proper control could be made four-fold more effective. When the law makes it possible to show good results, the tax-payer's hard sense will do the rest, and teach him that the proper use of his money is after all the most economical and most beneficial to himself. A few good roads will lead to more liberal expenditure and an extension of the system as soon as the users of roads begin to realize the benefits of system and proper control, as contrasted with the lack of system and practically no control at all so common to-day. The Western Pennsylvania Society has set an example that engineers everywhere, individually or collectively, should not be slow in following.

A LATE bill enacted by the New Jersey Legislature authorizes the building of a railway bridge across a certain stream, but prescribes that this bridge shall be "a single sliding draw of not less than 100 ft. opening." As a result, we are asked to refer parties to some authority which illustrates and describes a bridge that will meet the letter of this requirement. We are free to confess that we cannot do so. If a rolling bridge is meant, which is probably the case, some of the best examples in operation are to be found in Boston, though we do not now know of any detailed description of them. The ambiguity of the bill in prescribing the type of bridge desired is most probably due to the technical ignorance of some one of the New Jersey legislators, who did not want a swing-bridge and could not properly describe the bridge he did want. The limitation of the bridge to a "single" draw of 100 ft. opening makes even a rolling bridge a very expensive solution of the problem, whether this bridge moves on the line of the railway or diagonally to this line. The only railway bridge of the first description that we know of was the old Gray's Ferry draw over the Schuylkill in Philadelphia, and there the opening was only about 50 ft., and the tracks had to be pumped up to grade by hydraulic jacks after the draw was closed. If any of our readers can solve the problem as stated, our correspondent would no doubt be glad to hear from them.

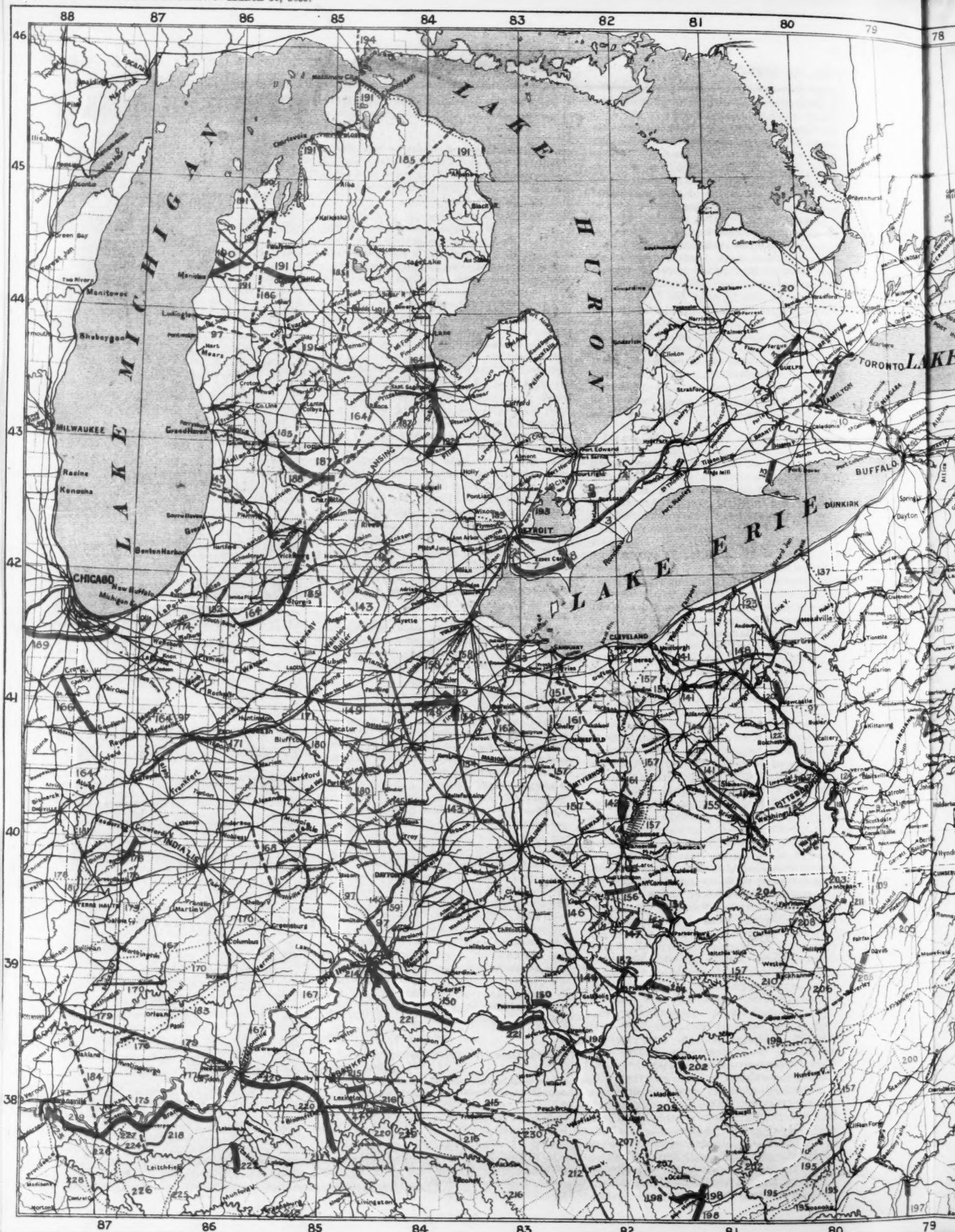
WE have received from a correspondent the following letter:

A bets B that the United States Government has the fastest war-ship in the world. The bet is $25. Will you please decide the bet, and oblige. * *

We are pained, and we may say surprised, that any readers of this journal should indulge in the vicious practice of betting. We cannot consent to take any part in giving effect to an immoral and unlawful procedure of this nature; but as a piece of technical information of some general interest, we may say that A is right as to his facts, if not as to his actions. The U. S. Steamship *Vesuvius* is by long odds the fastest war-ship in the world so far as yet reported, having made 21.646 knots per hour in an open seaway over a 5-knot course, as more fully reported in our issue of Jan. 26, 1889. The next fastest war-ship, to our knowledge, is *El Destructor*, of the Spanish navy, which made about 20 knots per hour over a "measured mile," a very different kind of a test from that of the *Vesuvius*, and not nearly so conclusive. The Spanish torpedo-boat, *Ariete*, built by THORNYCROFT, of London, has made 26 knots per hour over a measured mile; but the *Ariete*, as noted more fully in our issue of Feb. 23, is a mere harbor-shell, of less than 5 ft. draft, and while this, in one sense, makes her performance all the more wonderful, she is not a sea-going vessel, and certainly not a "war-ship."

The HERRESHOFFS are now building a torpedo boat for the U. S. Government which is expected to beat the *Ariete's* record, although its contract speed is only 20 knots, and the builders only claim 23 knots as probable.

THE vexed question of sewage disposal in Toronto, Canada, long discussed and several times reported upon in all its intricacy, has been again studied and reported upon by Mr. SAMUEL M. GRAY, of Providence, R. I., and Mr. RUDOLPH HERING, of New York, two of the best known and most competent sanitary engineers in the United States. These gentlemen spent 80 days in studying the problem and in preparing their report, and charged $50 per day each for their services. These reasonable bills have given rise to some discussion in the Toronto water-works committee, and were characterized by one member at least as "an outrage upon the taxpayer." It would appear evident that, while the committee appreciated the importance of the problem sufficiently to secure the services of the highest professional authority in its solution, some of the members are not yet educated up to the standard of the commercial value of such services. And this is the more remarkable as coming from a section of the continent which should be familiar with English practice in similar cases. Had it been a question of legal advice, involving a similar large outlay of public money, the bill would probably have been looked upon as moderate, if presented by lawyers of equal professional standing. It is a curious illustration of the too current lack of appreciation of the true value of long and careful professional training and practical experience in a civil engineer that the same authorities who rebel at a fair compensation for valuable services too often stand ready to accept the advice and expend great sums of money upon the untried plans of some almost unknown engineer whose only recommendation is that he offers his services "cheaply." Even in Toronto, plans are already out which "effectually kill the experts' report"—in the opinion of the engineer who advances them. We have neither the material nor the space to discuss this particular case other than to again call attention to the fact that it is high time that the services of a civil engineer and the compensation due for such services was rated, as in other of the learned professions, purely upon the training, the experience, and the relative professional rank of the engineer. It requires an able man, deep study, and successful practice to become prominent in law or medicine; but with this prominence comes the privilege in these professions to charge fees in proportion to the service rendered, a privilege which is rarely challenged. The same rule should, and in time must, hold good with civil engineers, who must often decide in questions of greater aver-



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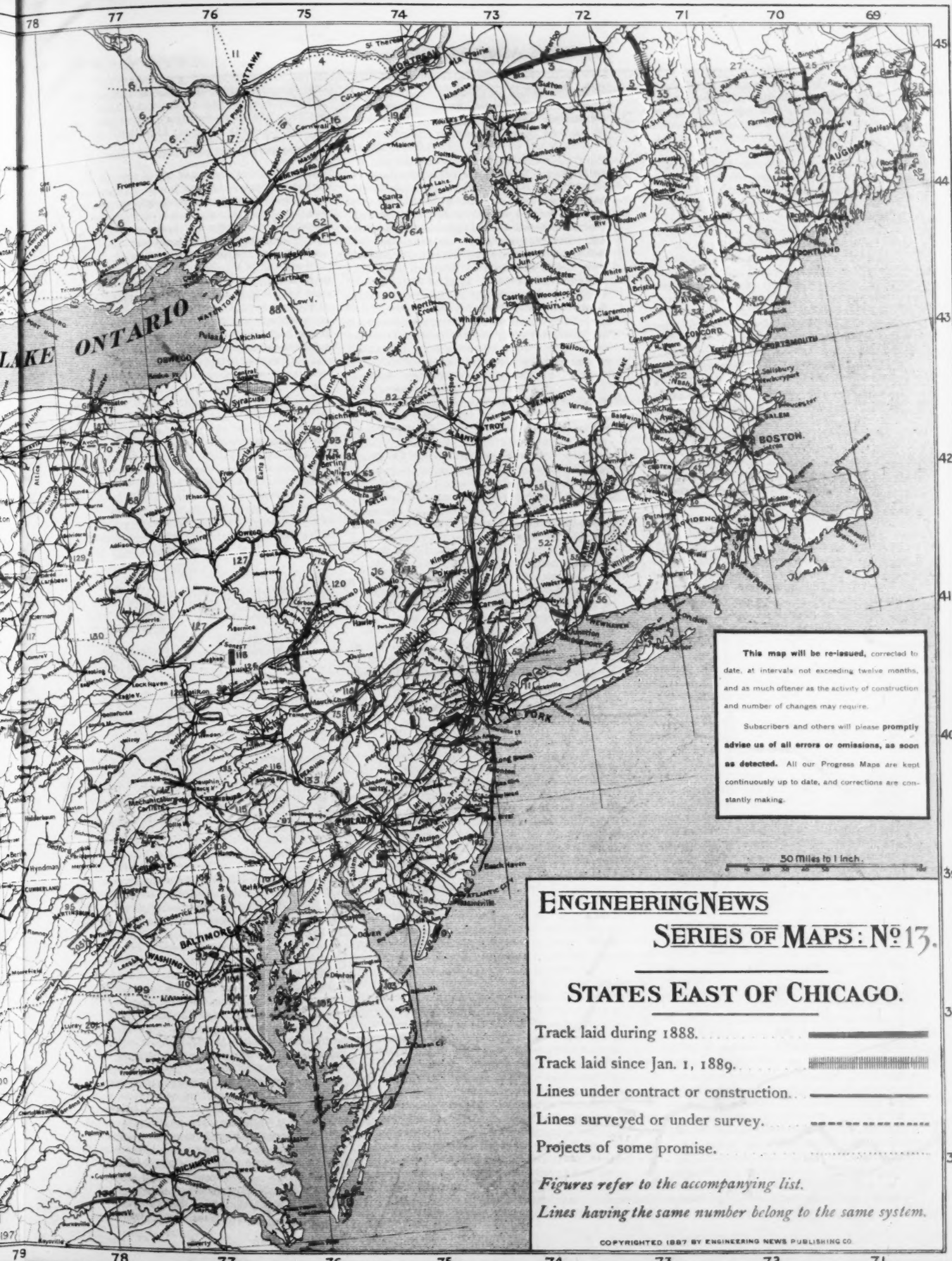

This map will be re-issued, corrected to date, at intervals not exceeding twelve months, and as much oftener as the activity of construction and number of changes may require.

Subscribers and others will please **promptly advise us of all errors or omissions, as soon as detected.** All our Progress Maps are kept continuously up to date, and corrections are constantly making.

ENGINEERING NEWS
SERIES OF MAPS: No. 13.

STATES EAST OF CHICAGO.

Track laid during 1888.

Track laid since Jan. 1, 1889.

Lines under contract or construction.

Lines surveyed or under survey.

Projects of some promise.

Figures refer to the accompanying list.

Lines having the same number belong to the same system.

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age commercial importance than does the lawyer, and who have the health and safety of the community quite as much under their control as any member of the medical fraternity.

Railway Construction East of Chicago.

We present to our readers with this issue the first number of our second series of maps of railway construction, showing the new lines of railway built since Jan. 1, 1888, and now under construction, surveyed, or projected with some fair prospect of completion. The idea is somewhat prevalent that railway construction is at a stand-still. Any person who believes this to be the case will find reason to alter his opinion on examination of our map and the list of new railways and extensions in another column. The fact, which appears at the close of the following table, that about 1,680 miles of railway are now under contract or construction in the States east of Chicago and north of the Ohio river is one which surprises even those best informed as to the activity of work in this section. Besides this, the 3,362 miles classed as "located or under survey" represents for the most part enterprises in which a very considerable amount has already been expended in preparatory work; and the prospects are that a good proportion of them will be placed under construction some time during the coming season.

We have included upon our map and in our list, and summarize in the following table, the mileage of track laid during 1888 as well as the work now under way and proposed for the present year.

Provinces	*Track laid*		*Under c'ntr'ct or con-str'ct'n*	*Loc't'd and under survey*	*Projects of some promise*
	In 1888	*To date in 1889*			
Ontario	93.3	.....	167	172	835
Quebec	122	10	280	97	211
N. Brunswick	51	.....	63	128	.....
Nova Scotia	11	2	181	40	.....
Newfoundl'd	26	.....	250	.....	.....
Total	303.3	12	941	437	1046
States.					
Maine	135.	.....	26	329	269
N. H.	3.	.....	21	.....	82
Vt.	19.4	2.5	.....	2	66
Mass.	6.6	.....	15	116	106
R. I.	.....	.....	4	.....	8
Conn.	17.3	.....	11	104	113
N. Y.	60.5	22.5	152	710	276
N. J.	31.	16.	62	14	123
Del.	10.8	.....	.....	.....	8
Md	6.5	.....	90	113	15
Penn.	102.9	1.3	392	169	400
Ohio	133.	30.7	426	503	503
Ind	86.1	.....	307	237	724
Mich.	241.2	.....	165	1005	237
Total	853.3	73.0	1677	3362	3039

On Oct. 8, 1887, when our last construction map of this section was issued, there were 1,458 miles of railway under construction, 2,187 miles under survey, and 2,214 miles of projected lines in the States east of Chicago and north of the Ohio river. It is thus seen that railroad construction in this section is now, and promises to be for some time, rather more active than it was in the "boom" year of 1887. The explanation of this surprising state of affairs is not a difficult one. For many years the flow of capital that annually seeks an investment in railway securities has been absorbed by the railway extensions which have been pushed forward to swell the mileage of the systems lying west of Chicago. The phenomenally bad year of 1888 has brought the work of railway extension in the Northwest and Southwest to a sudden halt. The capitalists of the East have therefore turned their attention to enterprises nearer home; and the best of the thousand and one possibilities for profitable extensions and new independent roads are being improved.

A similar comparison of the status of work in Canada on Oct. 8, 1887, and now, shows the following mileage record:

	Construction	*Surveys*	*Projected*
Oct. 8, 1887	982	651	880
Mar. 30, 1888	941	437	1046

From which it appears that the activity of work in Canada is about the same now as in the fall of 1887.

In the mileage of lines now under contract or construction, Ohio heads the list of States with 426 miles, but is followed closely by Pennsylvania with 392 miles. The explanation for this fact is found in the heavy coal and ore traffic which the mines of these States furnish. The somewhat uncertain returns from this sort of traffic seem to be an irresistible temptation to projectors of new railway lines. New York has 710 miles of new lines located and under survey; and a fair proportion of them will shortly be placed under construction. A considerable number, however, are local lines on which local capitalists have furnished the funds for the work thus far done: and it seems quite unlikely that they will ever be able to make a favorable enough showing for their enterprises to enlist outside capital.

A remarkable amount of activity is shown in that portion of the State of Kentucky included upon the map. The summary of the lines shown on the map (including about two thirds the area of the State and the districts of greatest activity) shows: track laid in 1888, 339 miles; now under contract or construction, 410 miles; located and under survey, 124 miles; projected, 457 miles. In West Virginia 40 miles of track were laid last year, 30 miles are under construction, 412 miles are under survey, and 600 miles are projected. The mineral resources of the State are certainly of great richness, and for the most part still remain undeveloped; but the prospects are that at an early date railway construction will become as active there as it now is in eastern Kentucky.

In our next week's issue we will discuss more in detail the most important of the new enterprises which are shown on our map, with the features of competitive policy which make them of general interest.

The Present Status of the Car Heating Question.

It is now barely two years since a succession of fearful fire disasters, culminating in the Woodstock and Bussey Bridge disasters, started an active and general movement in favor of steam heating of cars from the locomotive. Railway officers then were either hostile or indifferent to the movement, from lack of any positive evidence that such a system of heating was practicable. The entire technical press, with the exception of this journal, was likewise maintaining a cautiously noncommittal attitude; and we only felt justified in asserting (Feb. 19, 1887) that "if it were made unlawful for any train to run with fire on the cars *after a period of five years*, we anticipate that no very serious difficulty would arise in finding a system within that time which would be sufficiently satisfactory."

Within less than two years, this, and more than this, has been accomplished. At least a dozen systems have attained such measure of success as to have earnest friends, and to make it certain that any one of them would suffice if there were no other. Few railway men venture to dispute that steam heating from the locomotive is practicable on any part of our railway system; and those who do simply make themselves ridiculous. There is not another instance in the history of engineering of such rapid progress of a great reform, and this is the more remarkable because not a single great or notable fire disaster has occurred since that date to perpetuate and intensify the interest in the question.

The question has now attained such a stage that the most immediate and pressing need to hasten the universal use of steam heating is to agree on some form of standard coupling between the cars, and it is a significant sign of the times that the proprietors of one of the best, if not the best, of the possible couplings, has recognized the necessities of the case by agreeing to accept the very moderate and reasonable royalty of $5 per car in case his coupler is selected for recommendation as a standard as announced elsewhere in this issue. Other patentees are likely to follow this example, or to be practically thrown out altogether. There is therefore no apparent reason why action should not be had this summer at the Master Car Builders' convention which will practically settle the question, leaving the formally conclusive action, probably, to come a year later. In the meantime, nearly a majority of the passenger train cars in Massachusetts are equipped for steam heat; a large majority of the cars in New York are so equipped, and nearly half of the most important through trains throughout the country.

The reason for this wonderfully rapid progress, beyond doubt, lies simply in this: that the problem was not really so difficult as was generally feared, while it is found to promise, more fully than was at first realized, economy and convenience as well as safety. It is a notable fact that the strongest friends of the system are those who have experimented in it most fully, with few exceptions, and that the croakers are chiefly those who have so far held back, and done little or nothing.

It has been an impediment rather than an advantage, and an effect rather than a cause, of the rapid progress made that there have been so many different people with "systems," mostly patented, which they were endeavoring to establish, as a whole, in public favor. To attempt to compare "systems" of car heating, as a whole, is an absurdity, just as it would be to compare "systems" of heating buildings. Any one of a dozen systems, well planned and carried out, is better than any of the others poorly carried out. In car heating the whole question resolves itself primarily into (1) the question of steam supply, and (2) the question of distribution. The question of the sufficiency of the steam supply is no longer much disputed by intelligent persons. It is admitted that with heavy trains and in severe weather it demands an addition of from 2 to 5 per cent. to the steam otherwise generated for propulsion, and that, except under local and peculiar conditions, this steam can be generated and spared. No one would now take the position which our esteemed contemporary, the *Railroad and Engineering Journal*, assumed with much gravity after the Woodstock disaster, that it would only take *a half of one per cent.* of the usual locomotive steam supply to heat twelve cars, and yet, in effect, that it was all a visionary notion, and that the true cure-all was an iron box in each car with fire in it, or something of that sort.

The problem of distribution, in turn, likewise resolves itself into three parts, and only three, which are of any real importance:

1. The form of coupling, which it is highly desirable to make uniform and standard throughout the country.

2. The mode of connecting the couplings with the fixed steam pipes of the cars so as to permit the necessary irregular motion between car and car. This may be either (*a*) by hose, (*b*) by flexible joint metallic connections, or (*c*) by a coil of metallic pipe. It is not of the least importance to standardize the particular methods (*a*), (*b*) or (*c*), except as one or the other may finally be adjudged the best. All three may be used at discretion, even on the same road, *provided only th form of coup'er*

remains the same, and permits the use of any one of them without change.

3. The form of trap, by which the water of condensation is permitted to escape. This also it is not in the least desirable to standardize, nor has the question of its best form any necessary or direct connection with the merits or demerits of any "system" as a whole or any particular form of coupling and connections.

These three details agreed on, it does not affect the primary problem a particle what tricks be played with the fixed heating pipes within the car,—whether they enter it from the roof or from the floor; whether the trap be in the middle or the end of the cars; whether the steam circulates and heats direct, or heats and circulates hot water; whether there be any auxiliary heater in the car for use in emergencies or not. There will and ought to be great divergencies in respect to these details, depending on climate, length of run, and other local conditions. It is unfortunate, therefore, that the questions issued as to the merits or demerits of car heating apparatus should depend so largely on the final result of temperature maintained in the car. A "system" may wholly fail in this, from defect of some other detail, and yet have the best trap in existence; or it may have the best coupling and the poorest trap; or it may have both a good coupling and a good trap, and yet not heat the cars well.

It is hardly to be expected that any one man or company will devise the best details throughout for a system of steam heating. All that the railway public can reasonably ask of inventors is, *first*, couplings and connections which will effectively get the steam into each car and *secondly*, traps which will effectively get the condensed steam out of it; and these two demands should be more universally recognized as separate and distinct. Success in the piping process should not be regarded as having any connection with the steam heat problem proper, and might be much more effectively handled in the end if the proper officers of each road took it in charge themselves, since the best results will be differently obtained on different roads, according to climate and average number of passengers.

The one detail of steam heating apparatus which it is desirable to standardize and unify, the coupling by which it connects with other cars, offers an enormous prize to the cupidity of patentees. There are now upwards of 30,000 passenger train cars in the United States and Canada to be equipped with it, and each man, moreover, hopes that the adoption of his coupler will carry with it to a large extent the adoption of his "system." At a price of even $5 per car over cost of manufacture, the fortunate patentee who gets his coupler adopted will in course of time realize $150,000 from his invention, and that without further trouble or expense, for his market will be made for him by the fact of standardizing his device. In fact, he will realize much more, because the number of cars is doubling about every ten years. Moreover, few of the enterprising pushers of "systems" are in their hearts thinking of accepting any such trifling profit as $5 per car, even on the coupling part of it, if they can once get it adopted as a standard. So far as we now recall, the expression of a purpose to agree to ask no more, which we are authorized to make in another column for one of the most promising of the would-be standard couplers, in our opinion, is the first one of the kind which has been made. We are not clear that even so much as $5 is an entirely reasonable demand under the circumstances, in view of the fact that it carries with it a practical monopoly, and applies only to the coupling, leaving every one free to ask as much as he pleases for traps or coupling connections or any other detail of the steam heating process; but we are clear that any larger demand than $5 royalty per car for any coupler which is to be standardized should be regarded and treated as entirely out of the question, and that rather than consent to it some coupling like the Westinghouse hose coupling, on which there is no patent at all, should be selected, as we said last week, although it would be very unfortunate to select a coupling which did not readily permit of any other than hose connections.

This coupling question once settled, diversity may be permitted and even encouraged in respect to other parts of the apparatus, for years to come at least. "A fair field and no favor" to all should be the motto, and let uniformity come about at last, if it comes about at all, only by survival of the fittest. Some one or two traps, and some one or two types of coupling connections, are likely in the end to so establish themselves; but it is not likely that there will ever come a time when there will not be great diversity in the interior piping and circulating systems.

The Bridge Failures of Ten Years.

We give in another column an article which we are sure will be read with interest by all engineers and railway men, a complete list of the railway bridge failures of last year, so far as reported, with the name of the road and circumstances attending each, and, what is still more interesting, a complete summary of a similar record for the past ten years. Mr. STOWELL has done much excellent work in his position as bridge engineer of the New York State Railroad Commission, but no small piece of work more excellent or useful than the compilation of this record.

It is not particularly encouraging, from one point of view, to find that the total number of bridge failures for last year, 32, is among the largest of the series. In 1884 there was one more, and in 1881 and 1882 there was a still larger number, 38 and 34; but the total for the whole ten years is only 265, or 26½ per year. Omitting the first two years, for which the record is presumably imperfect, 239 bridges have fallen in eight years, or within a fraction of 30 per year. In the meantime, however, the railway mileage has enormously increased from 81,717 at the beginning of 1879 (93,349 at the beginning of 1881) to 149,913 at the beginning of 1888, an increase of 83½ per cent. from 1879 and 60½ per cent. since 1881; and, keeping this change in mind, the record shows a very gratifying decrease.

Dividing the record into two half decades, the casualties to all kinds and sorts of bridges, and to iron bridges only, from the different causes or circumstances of failures stand as follows:

Cause of failure.	*All kinds of bridges.*			*Iron bridges only.*		
	1879 -83	1884 -88	1879 -88	1879 -83	1884 -88	1879 -88
Fire	11	16	27	—	—	—
Freshet	15	24	39	1	3	4
Being repaired	1	7	8	—	1	1
Knocked down	28	33	60	6	14	20
Square fall	12	22	34	6	4	10
Unknown	58	39	97	3	—	3
Totals	125	141	265	16	22	38

Unfortunately, the record is so far imperfect that there is a very large number of bridges of which it is not even known whether they were built of wood, iron, or combination. The grand total stands as follows:

	1st 5 years	2d 5 years	Total
Known iron bridges	16	22	38
Known wooden bridges	44	56	100
Unknown material	65	62	127
Total	125	140	265

Thus nearly half the bridges which failed in both periods (52 per cent. in the first, 44½ per cent. in the last) were of unreported material; but this is a less important fact than might appear, because it is a practical certainty that the great bulk of the bridges whose material is unreported are built of wood. Wooden bridges are still in a large majority, and the fact of being of iron will almost always be specifically mentioned. The wood and unspecified failures (practically all wooden bridges) stand as follows:

Causes of failure	1879-83		1884-88		1879-88	
	Wood only	*Wood & unrep'd*	*Wood only*	*Wood & unrep'd*	*Wood only*	*Wood & unrep'd*
Fire	11	11	16	16	27	27
Freshet	—	14	6	21	6	35
Being repaired	—	1	5	6	5	7
Knocked down	6	22	5	18	11	40
Square fall	5	6	17	18	22	24
Unknown	22	55	7	39	29	94
Total	44	109	56	118	100	227

The contrasts are somewhat notable. Of the iron bridges, more than half have been knocked down by derailed trains, the proportion having notably increased in recent years. In the last half decade, nearly two-thirds (14 out of 22) of the iron bridges wrecked have been so destroyed. Of the remaining 8, 4 only were "square falls" (one of them the Bussey) and the rest due to freshets and repairs. From this it appears that there is 3½ times as much chance that an iron bridge will be knocked down by impact as that it will fail from inherent weakness. The single "square fall" of an iron bridge last year was No. 13 of the record, a through plate girder on the Richmond & Danville, which broke under a single engine as an effect of a rupture in a plate "floor-hanger."

Of the wooden bridges, including those of unreported material, as wood, as they practically all are, a much smaller *proportion* fail by "square falls" than of the iron bridges (10.6 against 26 3 per cent.), because of the great number of failures from other causes; but the very large proportion of unknown causes of failure (41½ per cent.) makes useless any attempt at comparing these causes of failure. The presumption is that this "unknown" return includes a larger proportion of "square falls" than it does of any of the other causes of failure, because, if there is any specific cause for failure, like freshet or fire, it is likely to be mentioned. On the other hand, the relatively small number of "knocked down," which ought to be quite as numerous in proportion to the total number of bridges as with iron bridges, indicates that many of the "unknown" belong to this class.

Unfortunately, no statistics exist by which the proportion of iron to wooden bridges in this country can be accurately determined. Taking a few of the State reports which come conveniently to hand and give this detail, we judge that in the States east of the Mississippi and north of the southern line of Kentucky and Virginia, including nearly half the total mileage of the United States, there is at the present time a considerably greater length of iron and combination bridges than of wooden, excluding always wooden trestles, which foot up to an immense aggregate, considerably larger than the total length of bridge spans, even in this region. In the South and far West the truss bridging sinks into insignificance in comparison, and there is perhaps three or four times as great a length of wooden bridging as of iron. Taking the whole United States together, we judge that somewhat over *one-third* of the truss bridging proper (i. e., of the total length) is now iron, but that hardly more than *one-fourth* of the number of spans,

if indeed so many, are of iron. These estimates are necessarily very rough, and may be far out, but we hardly think, after all, that they are so far out as to vitiate the comparison.

It will be seen above that, even counting in all the bridges of unreported material as wooden bridges, almost exactly *one-seventh* ($\frac{14}{128}$) of the reported failures of the past ten years are known to be iron bridges. Counting in a few only of those of unknown material as iron (say 6 out of 128), we have *one-sixth* ($\frac{20}{128}$) of the reported failures of ten years of iron bridges.

Considering how exceedingly defective have been the proportions of many of our wooden bridges, this is anything but a favorable showing to our iron bridges; for although they appear to be somewhat safer, they are not enough safer to make a very creditable showing for average American practice in iron bridge designing. We feel disposed to enter further into the discussion of the subject, but on the whole think it better to postpone all attempt to do so, till we can present some other matter now lying on our desk, and in the meantime leave the facts here given to sink into the minds of our reflecting readers.

Brazilian Railways.

A special correspondent of the London *Railway News* gives some late items of interest concerning the railway system of Brazil gathered in a personal examination of the status of affairs there. At the close of 1888, 5,281 miles of railway were actually constructed and 809 miles were nearing completion. With 14,000,000 inhabitants, therefore, Brazil has one mile of railway for every 2,650 persons, while the United States with 60,000,000 people has one mile for every 444 persons. After 400 years of occupation, settlement is still almost totally confined to the sea coast and to the banks of the great rivers. The vast interior is an elevated plateau, with occasional ranges of hills and low mountains; but it is almost as yet literally unknown and can only be made available by an extensive system of railways. At present the railways only pierce the ocean fringe of the Empire.

The Brazilian Government has always shown itself desirous of promoting railway construction and extension, and it now guarantees a capital of about $100,000,000 in State railways; and in addition to this about $52,000,000 is invested by foreign capitalists in unguaranteed railways.

The Government has recently published a long list of lines for which it is prepared to grant concessions and to guarantee 6 per cent. interest for 30 years, provided that the cost of construction and equipment in no case exceeds about $27,000 per mile. The most important of these contemplated lines are the following: A connection of the Bahia Central with the line to San Francisco. A railway 35 to 40 miles long between Cape Rio and the town of Nossa Senhora da Conceicao do Rio Bonita. To extend the Minas and Rio railway to the Rio Verde at a navigable point.

The bulk of Brazilian railways have the one metre gauge (39.37 ins.) though there are many exceptions ranging from 1.20 to 1.67 m., and several narrower than one metre. The roads are generally laid with native wood ties, with American pine and metal ties as exceptions. An official publication names 33 varieties of native wood suitable for railway ties. The locomotives and rolling stock come from England, the United States, France, and Belgium.

The most northerly railway projected is intended to connect the rivers Madeira and Mamore by avoiding 370 miles of falls and rapids. This road would be nearly 200 miles long, but there are unusual difficulties in carrying it out. This is the road conceded to Col. CHURCH in 1870, and contracted for about that time by Messrs. P. & T. COLLINS, of Philadelphia, for $29,500 per mile complete. The Brazilian Government guaranteed 7 per cent. for 30 years on $2,000,000 to supplement $4,250,000 cash applicable to the work. But though a survey of a part of the line was made, the expedition was a disastrous one to all concerned. At the petition of Col. CHURCH, the Imperial Government has lately had extensive surveys made, and estimates the total cost, including stations, bridges, rolling stock, etc., at $4,368,370.

In the Province of Para the only road open runs from Belem to Braganca. In 1885 only 36 miles had been completed, the official railway statistics not extending beyond that date. The Sobral Railway connects the port of Camocin with Sobral; it is about 77 4 miles long and is operated by five Baldwin locomotives and 45 cars of all kinds. In 1884 this railway did not pay expenses. The Baturite Railway starts from Fortaleza, in the Province of Ceara, and extends to Canao, a distance of about 66 miles. These are the main railway lines now in operation in Brazil.

The Proposed Pennsylvania Road Law.

The subject of the improvement of country roads, and the framing of a new law to better control this work, has very properly been taken up by the Engineers' Society of Western Pennsylvania. And as a result of the labors of Col. T. P. ROBERTS, Mr. ALEX. DEMPSTER, County Engineer GEORGE DAVIS, Mr. JOHN JOHNSON, and Mr. ARTHUR COOK, the committee to which this matter was referred, a bill has been submitted to the Pennsylvania Legislature. This bill provides that all roads and bridges, except in cities and boroughs, shall be under the care and control of a board of road trustees, to be elected in each township in February, 1890, who are to serve one, two, and three years respectively. These trustees must be citizens and freeholders, and shall meet in annual convention in their respective counties to elect a president and clerk, the latter to serve three years, and be entitled to the same compensation as a Clerk of the Courts. At the first meeting the trustees are to report the mileage and total amount of road taxes assessed in the several townships in 1889. A certified list shall then be submitted to the County Commissioners, who shall require the Assessors to collect in cash the township road tax that was paid in 1889. The convention shall also elect a suitable man, who has had at least 10 years experience as a civil engineer, as County Engineer, and who shall be paid the same salary as a County Commissioner. The County Engineer shall engage such assistants and pay them such salaries as the President of the Convention may approve. All improvements on roads are to be done by contract whenever possible, and the classification of roads under three main heads according to importance is recommended.

The Past and Present of Pittsburg Natural Gas.

A recent circular, relating to a proposed new mortgage loan of $2,500,000, of the "Philadelphia Co.," GEO. WESTINGHOUSE, President, and CHAS. PAINE, Vice-President and General Manager, which practically controls the natural gas supply in and around Pittsburg, gives a succinct statement of the past and present of this great product, which we abstract as of general interest, although in part the same information has already appeared in these columns at various times. Unlike many such circulars, the statements in this, we have no doubt, can be implicitly relied on as correct.

Organization.—The Philadelphia Co. was reorganized May 24, 1884, under the provisions of a Special Charter, originally granted to the Empire Contract Company by an Act approved March 20, 1871. The rights, powers, privileges and franchises conferred by and in said Act of Incorporation are exceptional in their nature and value, and are enjoyed by no other natural gas company.

Business.—Notwithstanding the liberal scope of its charter, the business of the company is at present confined to the mining, conveyance, and sale of natural gas. Although the existence of this wonderful product has been known for centuries, and its utilization attempted in a small way ages ago, the year 1875 marked its first introduction in the manufacture of iron; and not until the product of the famous Murrysville Well was piped to Pittsburg in 1883, did the people of Western Pennsylvania realize its value and recognize in it the fuel of the future.

The Past and Present.—Entering the field in 1884, the Philadelphia Co. found it already occupied; but, equipped by the inventive genius of its promotor, Mr. GEO. WESTINGHOUSE, Jr., with many appliances for the safe conveyance of gas, and backed by a capital of $5,000,000 subsequently increased to $7,500,000, the Philadelphia Co. soon distanced its competitors. So great was the advantage gained by an unfailing supply of gas, superior facilities for delivering the same, and an almost entire immunity from accident, that finally most of the competing companies sought and obtained the privilege of incorporation with the Philadelphia Co., or placed their lines in its hands for operation under lease. Thus the company practically controls the gas supply of the cities of Pittsburg and Allegheny, and their suburban villages: also 13 surrounding towns and boroughs. Reference to the accompanying map [not engraved] will show the extent of the company's mains and their favorable location. Originating in the three greatest anticlinal reservoirs yet discovered, Murrysville, Grapeville, and Canonsburg, they carry the product of 200 producing wells to Pittsburg, by 19 different routes, supplying on the way the towns and villages mentioned. By a comparatively small expenditure, the adjacent fields of Bakerstown and Belle Vernon—where the company has large tracts of promising gas territory in reserve—can be made tributary to the company's supply.

The Low Pressure System.—The cities of Pittsburg and Allegheny are supplied with gas at low pressure through a system of mains and service lines, aggregating 258 miles in length, of which 206 miles, owned in fee by the company, cost considerably more than $2,500,000. This portion of the company's work is practically completed, nearly every street of any consequence having already been piped. The principal mains are of unusual size, being from 20 to 36 ins. in diameter. All city lines have been constructed in the most approved and substantial manner, with double joints, escape pipes, and other patent appliances, which, with automatic regulators and cut-offs, reduce the chances of accident to a minimum.

The company's plant now is:

	Miles.	
Pipe lines owned in fee	524.18	
" " operated under leases	185.29	709.47
	Acres.	
Gas lands owned in fee	381	
Gas and oil rights in fee	2,194	
Gas and oil leases	14,551	17,126
Gas and oil rights and leases of Leased Co.	16,773	
Total gas territory controlled Phil'a Co.	33,899	
Number of producing wells	200	
	Miles.	
Telephone lines owned in fee	121.75	
" " leased	65.50	187.25

Consumers.—On Jan. 1, 1889, the Philadelphia Co. was supplying 750 manufacturing establishments, including 38 iron and steel works, etc., etc., and 23,000 houses. The quantity of gas required for this service approximates 500,000,000 cu. ft. per day, which is equal to about 25,000 tons or 2,500 car-loads of coal displaced.

Earnings and Expenses from Oct. 1, 1885 to Dec. 31, 1888.

	Earnings.	*Expenses.*
1885	$533,495	$189,297
1886	1,635,886	579,743
1887	1,756,769	735,055
1888	2,524,159	741,653
Total	$6,450,309	$2,245,748
All new wells		225,657
Field pipe lines, station buildings, right of way and telephone lines		207,000
Rents paid leased Cos.		411,572
Total operating expenses, etc		$3,089,977
Net earnings		3,360,331
Less dividends paid		2,423,280
Surplus invested		$937,052

Since Jan. 1, 1888, "Gross Operating Expenses" include the total cost of all new wells, field lines, telephone lines and other items that might be charged to capital. Based on existing contracts, the estimated gross annual revenue now exceeds $3,100,000, an increase of nearly $600,000 over the gross revenue of 1888. Since Nov. 20, 1885, the company has paid 40 consecutive monthly dividends of one per centum each on the capital stock.

Assets and Liabilities.

Available assets.—Cash, bills, receivable, etc.	$884,897
Unavailable.—Real estate and plant	9,635,584
	$10,520,481
Liabilities.	
Capital stock paid in	$7,500,000
Accounts payable	111,736
Bills payable	1,971,693
Undivided profits	937,052
	$10,520,481

The circular further points out that to duplicate the Philadelphia Co.'s system of mains and service lines—constructed under the most favorable circumstances and occupying the vantage ground at every point—and, at the same time, to acquire an amount of gas territory equal in value and extent to theirs, if not impossible, would at least require double the capital they have invested. And as to the chance for increasing business, the circular states that adjacent to the company's mains in the cities and towns already piped, there are more houses to use gas for fuel than the number of those

already supplied. The reconstruction of mill furnaces on the regenerative principle, now being made the condition of continued supply, the extensive introduction of gas-saving appliances, and the sale of gas for domestic use by meter only, is expected to do away with the waste that has heretofore existed, and so reduce the consumption of gas at least one-half. This saving, it is believed, will enable the company to furnish the houses still unsupplied and thereby greatly increase its revenue. By the employment of incandescent and other patent burners, the use of natural gas for illuminating promises a handsome income in the near future.

To take up the floating indebtedness of the company and provide for an extension of the main lines and distributing system as soon as desirable, the stockholders have authorized an issue of mortgage bonds to the amount of $2,500,000, of which the company proposes to place at present $1,500,000. The mortgage provides for a payment annually of 10 per cent. of the amount of the bonds, less the accumulated interest on the sinking fund in the hands of the trustee, so that the bonds secured by the mortgage will be extinguished on Nov. 30, 1898.

CORRESPONDENCE.

A Rock-Drilling Challenge.

NEW YORK, March 21, 1889.

TO THE EDITOR OF ENGINEERING NEWS:—

We desire, through this journal, to respectfully challenge the Rand Drill Co., to a competitive test between one of their "Little Giant Drills" and the "Sergeant." Both drills to be new, of equal diameter of cylinder, and to be operated in rock equally as hard as that drilled in the so-called "Power drill test at the Ludington Mine." The holes to be drilled in all the varied positions experienced in mining Lake Superior ore.

A fair condition of the test would be that the defeated party should pay all the expenses. The various details can be readily arranged, and a satisfactory referee appointed. We offer as a suggestion, the editor of the "Engineering and Mining Journal" or the Secretary of the American Institute of Mining Engineers.

Our friends, the enemy, have been having a good deal of fun of late all to themselves, publishing startling tables giving results of their own "Ludington Test," "Stone Mountain Test," etc., etc., putting big "Rand" drills against little "Sergeants," calling "new" drills "old," and "old" drills "new" in open defiance of the Ninth Commandment and the facts, and figuring up a saving in fuel that threatens to play havoc with coal stocks. So now, Mr. Editor, let the public have a trial that the truth may be known! Yours truly,

INGERSOLL-SERGEANT ROCK DRILL CO.
WM. L. SAUNDERS, *Sec. and Engr.*

Instruction of Railway Employes.

March 23, 1889.

TO THE EDITOR OF ENGINEERING NEWS:—

You mentioned in your issue of March 2 that the Wabash Railway had created a new office, that of an instructor of railway employés. This is certainly a move in the right direction, and it is to be hoped that other roads will follow the example. The importance of something of the kind being done has lately been very strongly impressed on my mind, it having come to my knowledge that several accidents, one resulting in the loss of several lives, have been occasioned by the gross disregard of the rules of the road on an important railway within the last few months. Any system that would teach the employés the rules, and the importance of remembering and promptly obeying them, would help materially to lessen the number of accidents, and be a direct monetary gain to the railway companies, as well as a contribution to the safety of traveling.

I would suggest the use of a model of a railway line embracing say four stations, on which miniature trains could be moved to different positions by the examiner, who should question the dispatchers, agents, operators, train hands, and switch men how they would act if they were placed in a like situation to the one illustrated. The answers to the questions would be a good guide as to whether the employé was competent to take or hold any particular office. N. S. D.

Ventilation of Sewers.

BOSTON, Mass., March 5, 1889.

TO THE EDITOR OF ENGINEERING NEWS:—

Every one knows that from the smallest crevice in the sewer pipes a foul gas will escape. If the defect in the pipe is in the basement of the house, the escaping gas will soon ascend so as to pervade every room in the house above and furnish conditions for disease and death.

This tendency to rise from the sewer is the effect of two causes that are ever present and come from chemical action in the sewage itself. The result of decomposition is a great amount of hydrogen, which is the lightest of all gases and always rises unless confined.

Another cause is the rapid increase in volume, growing out of the conversion of solids and fluids into gases by fermentation. If there was no escape, this would eventually force an exit at some weak point. The light hydrogen determines the direction of the action of this second force, and so there is ever a tendency of the gases to escape upward; and were it not for this tendency to rise when set free, gas enough would escape in any city to poison the atmosphere about our heads.

Now, if we take advantage of these two facts, all the sewers of any city can not only be ventilated at trifling expense, but the gas itself can be utilized and consumed so as not to exist in an injurious form even in the upper regions of the atmosphere.

All that would be required is to connect the sewer at several of the highest points with the high chimneys of the most active furnace fires in that neighborhood. Even if there were no fires, the gas would rise to and through the chimney; but if the fires were active, the sewer gas would be drawn in from long distances and with force.

But if the ventilating flue entered the furnace *below* the fire, both the carbon and hydrogen would have value as both would be consumed, and the sewer gas be entirely rid of deleterious elements before mixing with the atmosphere above.

But there should be a branch pipe opening into the chimney above, so that when there is no fire the sewer gas may be turned into the chimney above, where it would naturally rise higher than if spread through the atmosphere on the surface of the earth.

In the able report of the Superintendent of Sewers in Boston for 1887 he says:

When a manhole having a perforated cover is located in front of a dwelling, complaints are almost always made of the offensive odor arising from it, and a demand made to substitute a closed cover.

But this can only be done "*in the most pressing cases*" because the gases would be more concentrated and the trouble be aggravated. Two remedies are suggested. First, a number of small vents carried above the house-tops, which he says "*would be quite expensive*," and therefore he prefers "a ventilating plant at the outlet of the system" costing by his estimate "only" $23,000. Now the estimate of the power required to "reverse the natural flow of the gases" has not yet been proved. The present writer fully believes that if ample connection were made with a furnace chimney, say at the State House on Beacon Hill, it would ventilate a larger area than any plant at the outlet costing thousands, and the gases would furnish a good part of the power to do the work.

But I write more especially to suggest that it would cost but little to connect the sewer with the chimneys of several large foundries, etc., and in such numbers that, even if several were discontinued by changes and repairs, enough would remain to secure perfect ventilation without cost for operating. A moderate bonus would secure the right from owners of a hundred high chimneys.

Yours truly,
O. H. W.

[Such a method has been much discussed, and to some extent used. Under proper conditions, it is unquestionably effective. There are, however, several difficulties. Suitable furnaces are not always convenient. When the furnaces happen to be without fires, the sewer connection is a source of danger; and more than all else, the gases most to be feared are not generated in the sewer itself, but in the house drains, and gases there formed are little likely to be drawn downward into the sewer, and so away. Still, the plan has much to commend it, and, properly carried out, might be made a benefit to any city.—ED. ENG. NEWS.]

A Water-Supply Problem.

City Water-Works Office,
LYNCHBURG, Va., Feb. 22, 1889.

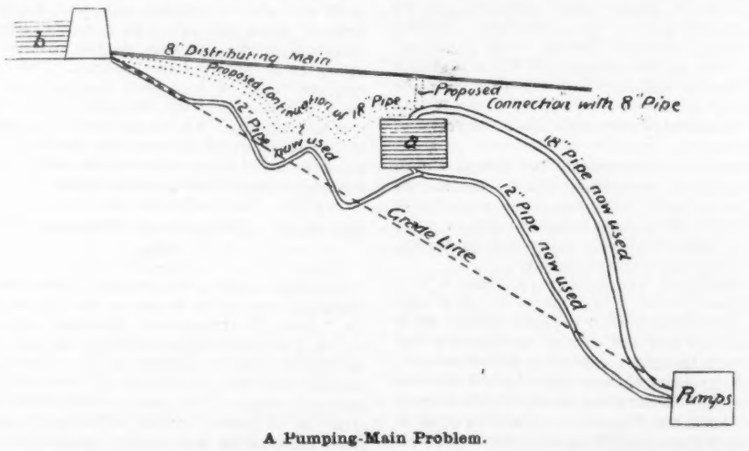
TO THE EDITOR OF ENGINEERING NEWS:

I find in this week's issue (Feb. 16) of your journal an article by Mr. E. SHERMAN GOULD on "Discharges of Long Pipes." I am especially interested in this, as Mr. GOULD illustrates in Fig. 2 the reverse of the position of our pumping main, a sketch of which I here give.

What we want to know is what advantage could be obtained by connecting with an 8-in. main at *a*? We now have a 12-in. main under a pressure of 130 lbs., and also an 18-in. pipe as far as the low reservoir (*a*) under 90 lbs. pressure. What would be gained by extending the 18-in. pipe to the upper reservoir (*b*) on or below the grade line from *a* to *b*? We have two plans under consideration. One is to continue the 18-in. main from lower to upper reservoir; the other plan is to connect with the 8-in. distributing main, and pump through that. The pressures given are reckoned from the pumps. Now, what are the relative advantages of each of these plans, as compared with the 12-in. main now in use which bobs up and down over the grade-line? Yours truly,

J. B. PAGE.

[Our correspondent submits a problem without sufficient data for its proper solution. But from the material available in the sketch and letter we would advise as follows: As we learn from our own statistics that the two reservoirs are at elevations of 330 and 255 ft. above the pumps, the quantity to be supplied to the upper reservoir, and the power of the pumps are quite as important elements as the size and location of the pumping mains. If pump-power is sufficient, and the consumption small, it would seem best to disconnect the existing 12-in. main from the low reservoir, and devote it solely to the high-service. The next plan would be to compare the relative economy of continuing the 18 in main, with the establishment of a second pumping lift at the low reservoir. The best plan of all, however, would be to secure the services of a competent consulting engineer in the matter.—ED. ENG. NEWS.]



A Pumping-Main Problem.

Sounding Tools and the Manner of Using Them.

MONTREAL, March 21, 1889.

TO THE EDITOR OF ENGINEERING NEWS:

Among the thousand and one different things that have to be done in the whole profession of engineering is sounding or boring the beds of streams, rivers, etc., to enable us to determine the kind of foundation most suitable. I have taken your valuable journal during the past few years, but have never noticed any articles or illustrations of different kinds of sounding augers or other tools for like purposes. For the benefit of the profession generally, could you not publish such, either your own or of brother engineers? I have my own ideas of the requirements, and am using tools made accordingly, and doubtless other engineers have theirs, but would be glad if you or they would publish them with illustrations. E. B.

[We submit this letter to our readers in the hope that from some one among them we can obtain good material relating to this important but somewhat neglected branch of engineering literature. Sounding practice varies widely with the material

to be tested; but as an engineer never knows just what class of soil he may next be called upon to examine, any experience in this direction is well worth describing and illustrating, and will doubtless be welcomed by many engineers. As the professional interest is a common one, we would suggest to our correspondent that, in the interval of gathering other data, a detail of his own experience and ideas of requirement would be a good start and would doubtless bring forth good fruit from brother engineers.—ED. ENG. NEWS.]

The Syphon Problem at Sayre, Pa.

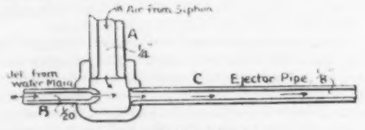
KANSAS CITY, Mo., March 14, 1889.

TO THE EDITOR OF ENGINEERING NEWS:

I have noticed the inquiry of W. A. S. in ENGINEERING NEWS and different solutions.

Having built two syphons, one 1,350 ft. long by 24 ins. diameter, the others 750 ft. long 42 ins. diameter, and kept them in successful use for years, I can offer what I consider the best solution.

In any syphon, air is disengaged from the water by decrease in pressure and will soon fill the upper part of the syphon, and break the flow; this must be eliminated, and this action should be practically constant. If water pressure is available, it furnishes the cheapest and easiest method. A jet $\frac{1}{32}$th of an inch, if the syphon is nearly tight, is probably more than ample. To use it, make an ejector in the usual manner of steam injectors as per sketch, adapted to 16½-lbs. vacuum with 60 lbs. water pressure.



Syphon Problem.

In the illustration given, *a* is ¼-in. gas pipe connecting with air chamber at top of syphon; *B* is jet from water main, $\frac{1}{32}$-in. It is essential that this be truly centered with the ejector pipe *B*, of ½-in. base and should be so arranged as to be easily taken out, as so small a jet may be subject to obstruction. The pipe *c* should be smooth and straight, and not less than 1 ft. long; it would be better if 2 ft. long, and placed vertically. The size of the water jet can be adjusted by trial, but will be found about correct for ½-in. ejector pipe.

Respectfully, G. W. PEARSONS.

Notes, Queries and Answers.

C. E. C. There is no serious practical difficulty whatever in running moderately heavy passenger and freight trains with any of the modern locomotives much in use over a loop or semicircle with 250 ft. radius; the loop being in a city near a station, and to be used only for the purpose stated of connecting two different railroads, level grade, 2 or 3 trains per day only.

A Colorado correspondent wants some cheap and simple means of opening and closing sluice-boxes, head-gates, etc.—We lately illustrated a simple form of gate (Nov. 24, 1888), but what is now wanted is the practice in western irrigation and water-supply schemes. We have been long promised some material of this character, but in the meantime will be pleased to publish any illustrations and descriptions sent us.

V. M. C., Wardner, Id., asks: Would you kindly inform me if, to your knowledge, the "Brandt" drill is in use anywhere in the United States? It is a rock drill boring by rotation under high hydraulic pressure and used in Europe.—Our impression is that it is not in use in this country, certainly not to any large extent. It is an excellent drill, and has been largely used in Europe; but whether it has any decided advantages over the many rock drills in use here seems doubtful, in view of the fact that it has never secured commercial introduction here. The drill was fully described in ENGINEERING NEWS of Jan. 19 and Feb. 9, 1884. Perhaps some of our readers can give further information.

PERSONAL.

Mr. J. EDWIN JONES has been appointed Superintendent of Streets at Boston, Mass.

Mr. GEO. F. STONE, one of the Directors of the Richmond Terminal Co., has resigned.

Mr. J. A. BARNARD has been appointed Purchasing Agent of the Ohio & Mississippi, vice Mr. GEORGE STEVENS, resigned.

Mr. JOHN SCOTT, President of the Colorado Midland, will resign to become president of another company.

Mr. THOMAS M. KING has been appointed Second Vice-President of the Baltimore & Ohio; this position was formerly occupied by Mr. KING and has been vacant since his resignation in 1887.

Mr. J. H. WINDRIM has been appointed Supervising Architect for the Treasury Department.

Mr. F. B. CLARKE, Traffic Manager of the Chicago, St. Paul, Minneapolis & Omaha, has been elected Chairman of the Trans-Missouri Railway Association, one of the auxiliary divisions of the Interstate Railway Association.

Mr. GEO. E. BLAINE, Superintendent of the New York, Mahoning & Western, has gone to Mexico as representative of Richard Klegg & Co., who have the contract for building a railway.

Dr. WILLIAM GANARD, said to have been the first manufacturer of tool steel in this country, and who first engaged in the steel business in Cincinnati in 1840, died at Fallston, Pa., last week, at the age of 86.

Mr. J. C. STUBBS has been appointed General Manager of the Southern Pacific. He has been Freight Agent, General Freight Agent, Freight Traffic Manager, and General Traffic Manager of the Central Pacific.

Mr. A. H. MCCULLOH, formerly General Passenger Agent of the Cumberland Valley Ry., died at Chambersburg, Pa., March 22, at the age of 76. He retired in 1886.

Capt. SETH W. COX, a railway contractor of Birmingham, Ala., and formerly from Laurens, Va., was run over by a train and killed near Powderly, Ala., March 14.

Mr. CHAS. BLACKWELL having resigned from the Central Georgia R. R., answers to circular on Driver Brakes should be addressed, care of ANGUS SINCLAIR, Secretary, 140 Nassau St., New York.

Mr. DEXTER BRACKETT, formerly in the office of the City Engineer of Boston, in charge of water distribution, has been appointed Superintendent of the Water Department.

Col. CHARLES B. CHILDE has been appointed Consulting Engineer of the Chesapeake & Ohio, with headquarters at Cincinnati, O. He has been connected with the road since 1862 when the first company was organized for its construction.

Mr. COE F. YOUNG, for many years Vice-President and General Manager of the Delaware & Hudson Canal Co., died at Thomasville, Ga., on March 22. He was born in 1824. In 1864 he became Superintendent of the canal department of the company, and in 1869 he was made General Manager of the railway and canal systems. He retired about three years ago.

PUBLICATIONS RECEIVED.

—*Economic Value of Electric Light and Power.* By A. R. FOOTE. Robt. Clarke & Co., Publishers, Cincinnati, O. Price $1.

This is a work written for the users of electricity in language that all can understand. Mr. FOOTE treats, in a general way, of electric light and power, the various types of light, and their economic value, etc. A considerable part of the book is devoted to a reprint of special articles upon subjects having to do with electricity. In Part II the author advocates the municipal control and ownership of electric plant for all purposes, even of power; he believes that the true functions of government are to regulate and control, and not merely to own and operate, certain commercial industries. A very useful and satisfactory appendix by Mr. ALLAN V. GARRATT explains in untechnical language the mechanical and electrical terms peculiar to this new science.

—*Twelfth Annual Report of the Railroad Commissioner of the State of Virginia.* For the nine months ending June 30, 1888. J. C. HILL, Commissioner. 6 x 9 ins. 699 pp. Bound in half calf.

Almost the whole of this neatly printed volume is taken up with the detailed reports of the companies, and the remainder contains the official correspondence of the Commisson, leaving for the actual report of the Commissioner less than three pages, and a dozen pages for statistical tables. These latter we hope to abstract in an early issue.

—*Journal of the Engineering Society of the Lehigh University*, Bethlehem, Pa. February, 1889.

This number of the quarterly contains the following papers: "Backwater caused by Bridge Piers and other Obstructions placed in the Beds of Streams," S. W. FRESCOLN; "Slag Brick," J. B. WRIGHT; "Among the Line of the Nicaragua Ship Canal," EMIL DIEBITSCH: "Graphical Construction of Regular Polygons, F. A. WEIHE.

—*Report on the Water Supply of Lebanon, Pa.*—By ISAAC S. CASSIN, C. E., of Philadelphia, Pa. With the mayor's message.

—*Construction of Toronto Sewers.* By C. H. RUST, M. Can. Soc. C. E. Excerpt Minutes of the Transactions of the Society, Vol. II., Part II., Session 1889.

This paper and the lengthy discussion following it enter most fully into the construction of the sewers referred to, treating both of brick and pipe sewers, and giving details of construction, cost, etc. The paper is a very creditable one both to its author and the Society of which he is a member.

SOCIETY PROCEEDINGS.

American Society of Civil Engineers.—The following circular of inquiry from the committee on form of rails and wheels, etc., has been issued:

The committee, having issued a preliminary report giving in full all the facts which they could collect and the preliminary conclusions which they seemed to warrant now desire to obtain the views of members and those interested in the subject on the following specific points, to aid in drafting their final report, which they propose to do if possible within a month.

Prompt reply to this circular will be a great favor. The Committee's preliminary report was published in the *Transactions* of the Society for July, 1888, a copy of which has been sent to you or will be sent at once on application to JOHN BOGART, Secretary, 127 E. 23d St., New York.

(1.) Do you consider that the evidence submitted, together with the results of your own experience and observations, warrant accepting as final conclusions the preliminary conclusions as to causes of sharp flanges, outlined, etc., at the foot of page 28? If not, please state your objections.

(2.) Do you consider, on the same basis of fact and personal experience, that the preliminary conclusion, as to rail-wear stated near the bottom of page 35, "that the rate of rail-wear grows very materially greater as the rail corner is rounded off to fit the fillet of the flange" may properly be accepted as a final conclusion? If not, please state your reasons.

(3.) Do you consider that the engravings on page 38-9, with your own observations and experience, warrant the conclusion that worn rails in service take a top radius of about 12 ins., seldom much less or more, and a corner radius of about ¼-in., or somewhat more? If not, please state your own conclusion.

(4.) Do you regard as warranted by the evidence the preliminary conclusions stated in the two paragraphs at the bottom of page 44? If not, why not.

(5.) Do you regard as warranted the preliminary conclusions as to fillet radius, on page 45, at the end of the report? (The Committee may state that several wheel-makers have stated to them that a large fillet radius helps decidedly in getting a good chill.)

(6.) What objections do you see against the recommendation of a rail top like that of cut on opposite page (a lately adopted standard of the Michigan Central railway published in ENGINEERING NEWS March 9)?

Please state if you approve or not these features of it; with your objections or proposed change.

A. The ¼-in. corner radius?
B. The 12 ins. top radius?
C. The vertical sides?
D. The very small lower corner radius?
E. The broad head relatively to depth?

(7.) Mr. DON J. WHITTEMORE, past President, Am. Soc. C. E., Chief Engineer of the Chicago, Milwaukee & St. Paul Railway, in a paper to be published immediately by the Society, but which has appeared nearly in full in ENGINEERING NEWS of Feb. 9, 16 and 23, and an abstract in various of the railroad papers of about that date, objects to any top curve at all, and proposes an entirely flat top between the rail corners. Do you deem this likely to be effective in reducing rail-wear?

(8.) Do you see any gain from the curve or objection to making the rail top flat instead of slightly curved?

(9.) Do you advise recommending an entirely flat top?

Answers are invited from all interested, whether members or not, and are to be sent to Committee on Rails, care JOHN BOGART, Secretary Am. Soc. C. E., No. 127 E. 23d St., New York.

The Special Committee on Standard Time has respectfully reported as follows:

The last annual report of the Committee referred to action which had been taken by the General Time Convention, the year previous, with the view of securing an expression of opinion from members of that association on the subject of the twenty-four-hour notation.

Circulars had been sent out by the Secretary of the General Time Convention, directing attention to the contents of a pamphlet issued by the American Society of Civil Engineers, setting forth the experience which up to that date had been gained on the Central and Mountain Divisions of the Canadian Pacific Railway, where the new notation had been in use for some months. A series of questions also accompanied the circular, to which members of the General Time Convention were requested to furnish replies.

The replies were referred to in the last annual report of this Committee, where, among other things, it was stated that 61 affirmative and 38 negative replies had been received in reference to the question, "Are you in favor of the general adoption of the twenty-four-o'clock system of counting the hours—abandoning the use of A. M and P. M.?"

It was deemed important to ascertain the precise character of the negative replies, and accordingly application was made to the Secretary of the General Time Convention, Mr. W. F. ALLEN, for copies of the objections which had been offered. Through the courtesy of that gentleman, the information has been received since the last Annual Meeting of this Society.

An examination of all the replies containing objections shows the following expressions of opinion, viz.:

6 That the A. M. and P. M. system is good enough.
5 That there is nothing to be gained by a change.
4 That the people should be educated to the new system before the railways adopt it.
3 That the adoption of the change would cause great confusion.
2 That it will be impossible to get men to understand the new notation.
2 That it is advisable to delay adopting the new notation until more experience is gained on the railway s now using it.

2 That doubts are entertained if it can be brought about.
2 That its adoption should be delayed until all the railways are prepared to adopt the change simultaneously.
1 A preference is expressed for the decimal division of the day.
1 That midnight should be designated ZERO or 0, in place of twenty-four hours.
1 Has difficulty in offering any serious objections to the new system.
1 Does not think it concerns the public very much.
1 That it is for the Government to authorize the adoption of the new notation rather than the railways.
1 Is of opinion that the change would involve great expense.
1 That there will be some objection to the change whenever it may be made.
1 Is not sufficiently familiar with the working of the new system.

The deductions from this analysis are, that of the ninety-nine railway managers who in April, 1887, furnished replies to the questions placed before them, there were only six who considered the A. M. and P. M. system good enough, and only five who were then unable to recognize the advantages of the new notation. That the objections were not considered very serious by the writers of them is evident from the fact that in 21 of the 38 negative replies, it is stated that they will be prepared to adopt the twenty-four-hour notation if the connecting lines do the same.

The objections which have been raised are met in the most convincing manner by letters from railway men who have now had from two to three years' daily experience in the use of the new notation in operating railways. These communications are placed at the service of the Committee, and comprise the following, viz.:

15 Letters from managers, assistant managers, superintendents and assistant superintendents.
7 Letters from train dispatchers.
8 Letters from conductors.
25 Letters from station masters.
18 Letters from track masters and track foremen.
2 Letters from yard masters.

There is a singular unanimity of opinion expressed in all these letters in favor of the new system. At present, your Committee cannot do better than submit the two communications which have been last received, viz:

First.—A letter from Mr. COLLINGWOOD SCHREIBER, General Manager of the Intercolonial Railway of Canada, dated the 9th instant.

Second.—A letter from Mr. W. C. VAN HORNE, President of the Canadian Pacific Railway, dated the 10th instant.

From Mr. SCHREIBER:

DEAR SIR,—I have your letter of yesterday's date, making inquiry as to whether or not the twenty-four-hour system of time notation is still in use upon the Government railways, and if so, desiring to be informed if it gives satisfaction.

In reply I may say, the twenty-four-hour time notation was introduced upon the Inter-colonial Railway (906 miles) and the Eastern Extension Railway (80 miles) on June 13th, 1887; that it has been in most successful operation from that date to this. I anticipated at the time some trouble in having such a novelty introduced, imagining the public press and the employés of the road would combat it, but such has not been the case; not a word of complaint, so far as I am aware, has appeared in the newspapers upon the subject, and our officers and employés, as a rule, appear to view it as an advancement in the right direction, those employés immediately connected with the movement of the trains especially favoring the system. Under this time notation system no confusion can arise, and for this reason greater safety is assured.

For my own part, I may say I am strongly in favor of the twenty-four-hour system of time notation, and I propose, so soon as the Oxford and New Glasgow Railway (70 miles), and the Cape Breton Railway (100 miles) now under construction, are completed and turned over to the Operating Department, to extend the system to those lines. I think it would be an advantage if it was more generally used by the railways, and I hope, at no distant day, to see its use very much extended; in fact, it appears to me it would be a great advantage if the railway managers throughout the Continent would put the twenty-four-hour system of time notation in operation upon their roads; it certainly could not but be fraught with good results. I may, however, remark that I do not think the public will readily take it up for general use until such time as it is taught in the public schools; if this was done, I believe it would very soon come into use for all purposes.

From Mr. VAN HORNE:

Replying to your note of Jan. 6, I am happy to be able to say that our nearly three years' trial of the twenty-four-hour system on all of our lines west of the Great Lakes, embracing 2,354 miles, has been highly satisfactory. No confusion whatever resulted from its adoption or has grown out of its use, and I have yet to hear of the first objection to it on the part of the public.

The Manitoba and Northwestern Railway Company, 207 miles, and the Northwestern C. and N. Companies's Railway, 110 miles, also follow this system. It is therefore the only system used for railway purposes north of the forty-ninth parallel and west of the eighty-ninth meridian.

We hope soon to be able to extend this system over all the company's lines in the East. We should have done so before this time, if some of our neighboring lines had been in a position to join us in the movement.

A short experience with it must, I believe, convince everybody that it is vastly superior for railway purposes to the old system. It takes a surprisingly short time to come to think of twenty o'clock instead of eight o'clock P. M.

There is no danger in its adoption, even on a very busy line. The term 19.47, for instance, in a train order, cannot be mistaken for anything else.

These letters conclusively establish that the new notation has been thoroughly tested for two or three years on 3,657 miles of railway, that no difficulty whatever has been experienced in introducing the change, that it has been really accepted by the public without a single objection being heard, that its extreme simplicity and the impossibility of errors resulting from its use facilitates the movements of trains and promotes the public safety. The new system having thus proved so satisfactory in every way, it has now been determined to employ it on 3,053 additional contiguous miles, which will make a total length of 6,710 miles of railway shortly to be operated under the new notation.

It is obvious that there can no longer be any doubt as to the practical advantages of the new system, and the ease with which it can be applied to the operating of any line of railway. The thirty-eight negative replies which have been cited cannot be said to present insuperable difficulties, and it is believed that the writers of them will now have their views greatly modified by the experience which has since been gained and the explanations made in the more recent letters which have been submitted.

Your Committee cannot but think that in the public interest it is advisable that renewed efforts be made to secure the general adoption of the new notation.

SANDFORD FLEMING,
Chairman Special Committee.

Boston Society of Civil Engineers.—The annual meeting of the Society was held at its rooms, Boston & Albany R. R. Station, Boston, on Wednesday, March 20, 1889, at 19 o'clock, President FITZGERALD in the chair, 74 members and 12 visitors present. T. T. HUNTER HARWOOD, CHARLES W. HOWLAND, and GEORGE A. WETHERBEE were elected members of the Society, and four candidates were proposed for membership.

The President announced the death of WM. S. BARBOUR, Member, which occurred Feb. 24, 1889, and a committee was appointed to prepare a memoir, consisting of G. A. KIMBALL, A. F. NOYES, and G. E. EVANS.

Annual reports of the various committees were presented and read.

The reports of the Government of the Society and the Treasurer show the year to have been one of marked prosperity for the Society; 37 new members have been added, making the present membership 219: 215 active and 4 honorary members. The report of the Treasurer shows a net gain of $411.99 to the funds of the Society, and the Librarian reports an addition of 425 numbers to the list of books in the Library. Ten regular meetings have been held during the year, and the annual dinner this year was made a separate gathering. The average attendance at the regular meetings was 70, an increase of 43¾ per cent. over last year. The attendance at the dinner was 99. Nine excursions to works of professional interest have been made during the year.

The usual annual assessment of $6 was levied on all resident members, and the Society then proceeded to the election of officers, with the following result:

President, DESMOND FITZGERALD; Vice-President, JOHN R. FREEMAN; Secretary, S. EVERETT TINKHAM; Treasurer, HENRY MANLEY; Librarian, FRANK W. HODGDON; Member of the Board of Managers, WINFIELD S. CHAPLIN.

The annual address of President FITZGERALD was then delivered, and very fully illustrated by lantern views. He spoke of the progress and growing influence of the Society and of the general advancement of the engineering profession. He then described the development of the water power at Lowell, Lawrence, and Holyoke, and compared the different methods in use in each city. The engineering work done along our coast by the Government was then taken up, and the address closed with an account of what the Massachusetts Institute of Technology was doing to advance the science of engineering.

Engineers' Society of Western Pennsylvania.—At the meeting at Pittsburg, Pa., on March 19, the Report of the Committee, recommending a visiting card for use among the engineering societies of the country, was adopted, and the Committee instructed to confer with the Kansas City and other societies, with reference to the matter. The Report of the Committee on Improvement of the Country Roads was adopted, calling for a division of the roads of the State into highways, roads, and lanes; defining highways as what are commonly called county roads, leading entirely through the country, or from one important center to another; roads, as what are now commonly called township roads; lanes, as private roads, leading only to small hamlets or private properties. The draft of the law to be submitted to the Pennsylvania State Legislature, calling for road commissioners who shall appoint county engineers, who shall have charge and control of the improvements of the country roads: said improvements to be in shortening distances, lowering grades, and furnishing a good road bottom. The Committee were instructed to use every means to have this bill adopted by the State Legislature. A full report was read upon the "Advantages of Good Country Roads to the Community in General." A paper was read by JNO. A. BRASHEAR, on "Optical Glass," being an interesting description of the casting and grinding of glass, method of purification and annealing, and examination for internal strains of both flint and crown glass. The imperfections of glass were described as being due to improper annealing, leaving internal strains, which can be detected by polarized light; also to striæ, or chords, which are shown by lines running through the glass, which are liable to be formed in both crown and flint glass. These are shown by examining the glass with a lens, which gives a diffused light, and shows them up well in looking toward a bright light beyond. Stria is caused by non-homogeneity in the glass, from unequal density of the mass, and from mixture of alumina coming principally from the clay of the pots in which the glass is melted; it causes aberrations, which are cured when they exist in small areas by rubbing the surface down at the location where the stria exists, in that way changing the direction of the light so much as to throw it entirely away from the focal plane of the lens system, thus making it harmless. An interesting description was given of the method of cutting out the lenses from a block of glass with emery. This is done in 15 minutes. The speaker claimed that optical glass could be made in Pittsburg, and ought be; that it needed only the skill and patience of trained operators, such as have had long experience in France.

Engineers' Club of St. Louis.—At the meeting on March 20, OTIS E. HOVEY, A. L. JOHNSON, and HERMAN KRUTZSCH were elected members. The Secretary announced that a communication had been received asking that the club contribute such assistance as was in its power to the special exhibition of American railway inventions at the Paris Universal Exposition.

Prof. NIPHER addressed the club on "Plans of Investigations in Dynamo Designing." His remarks were illustrated by numerous drawings, and by formulæ and sketches on the blackboard. He explained in detail the principles involved, and showed how, when certain constants for any type of dynamo had been ascertained, the design of dynamo of the same type of any other desired capacity could be readily determined. He had recently made such a calculation for an Edison dynamo, which he used as an illustration. He gave two empirical formulæ for the safe carrying capacity of a wire in ampères. The cost of copper necessary in any dynamo, and the speed at which it could be run, were usually determining factors in the problem. Another important consideration is the resistance which the space around the dynamo offers to the magnetic line. It would be very desirable to have experiments made to determine this resistance for the prominent dynamos now in the market. Messrs. HOLMAN and BRYAN took part in the discussion of this paper.

Prof. JOHNSON then submitted a brief reply to Mr. WM. B. KNIGHT'S discussion of the paper on "Cable Yokes." Prof. JOHNSON was not ready to admit that the strength of cable yokes was a matter of great importance. He held that that the proper way to provide resistance to the closing of the slot was by increasing the strength of the conduit, and that if the strength could be greatly increased by a new form of yoke, without increase of expense, it was, in his opinion, the proper thing to do. In the discussion, Mr. THOS. MCMATH stated that, while the slot rails of the Citizens' cable road in St. Louis had been planed off at considerable expense, it was principally as a precautionary measure. Prof. NIPHER and Mr. HOLMAN also took part in the discussion, the latter calling attention to the large amount of cable construction in prospect and the importance of this question of strength of yoke.

In the general discussion Prof. JOHNSON called attention to a test piece of Mullens silicated iron, which in his testing machine had stood in compression 20,000 lbs. per sq. in. It had finally broken in the same manner as specimens of stone do. It contained a very large proportion of silica.

Mr. HOLMAN explained a new method of making large pipe connections to water mains without interrupting the flow of water. It was available on pipes as large as 12 ins. in diameter. WM. H. BRYAN, *Secretary.*

Northwest Society of Civil Engineers and Architects.—At the regular meeting at Portland, Ore., on March 13, 11 new members were elected, making a total membership of 31. Prof. GEORGE DAVIDSON, of the U. S. Coast Survey, Prof. THOMAS CONDON, of Oregon, and Mr. JOHN C. TRAUTWINE, of Philadelphia, were elected honorary members. At the meeting on the 27th, papers were contributed by various members of the society descriptive of the building stones of the Northwest, giving localities, class, and quality, cost of extraction, accessibility, convenience to market, and other details in connection with the subject.

Western Society of Engineers.—At the meeting of this Chicago society on March 6, E. G. NOURSE J. K. LYONS, C. C. BROKAW, and P. S. BURKE were elected members.

Mr. F. C. ROSSITER, of the Committee on Standard Drawing Papers for Engineers, reported as follows:

As one of the committee appointed to see what could be done towards inducing manufacturers of profile and cross-section paper to furnish engineers with translucent paper for blue printing purposes, will report that by correspondence I learn that one of our manufacturers will not try the experiment under any circumstances, and the other reports that profile paper can be made on thin bond paper, but it would be expensive, stating that sheets 21 x 33 ins. will cost 75 cts. Believing that this price is exorbitant, there being no reason in my mind for charging more than the retail price for sheet profile paper, I have had experiments made for lithographing profile paper and have succeeded beyond my expectation. The lines in this copy are too heavy, but can be reduced in the next. Blue prints taken from the bond and vellum cloth, printed in blue and green inks, give satisfactory results. Sample sheets are submitted herewith for inspection. My experimental sheets are only 10 x 12, but when satisfied that there will be a call for such paper I will have an engraving prepared 21 x 33, which I am satisfied I can furnish at 30 cts. per sheet for bond paper and about 60 cts. for vellum cloth.

Respectfully yours,
F. C. ROSSITER.

Mr. ROSSITER introduced some samples of profile paper which had been prepared for blue printing, and explained his experiences.

The resignation of the Treasurer, Mr. H. W. PARKHURST, was received and accepted, and the Secretary authorized to fulfil the Treasurer's duties until further action of the society.

The next meeting of the society will take place April 3, when a paper on "The Croton Valley Storage," by Mr. SAMUEL MCELROY, will be read, and important matters discussed.

Applicants for employment are requested to examine the report of the Committee in Proceedings of July 11, 1888, in order to comply with rules therein prescribed, before sending in their applications. Envelopes should be endorsed "Application," and should be addressed to G. A. M. LILJENCRANTZ, C. E., Post Office Drawer 132, Chicago, Ill.

JOHN W. WESTON, *Secretary.*

The Montana Society of Civil Engineers held its monthly meeting on March 16, with President B. H. GREENE in the chair and 11 members and one visitor present. The Committee on Highway Bridges reported upon the legislation proposed by the Engineers' Club of Kansas City to secure reform in the plans and construction of highway bridges. The committee considered the bill a good one for Missouri, but thought that Montana was too new a country to adopt such laws at the present time. This report was approved. The club expressed its approval of the alliance with other engineering societies, and left the details of the scheme to the board of managers of the Association of Engineering Societies. Further action was determined upon in relation to two bills lately presented to the Montana Legislature by the Society, one relating to town and village sites and plats and the other to the recording of mining claims. The former bill was approved by the Governor, but the latter was lost by a tie-vote in the council.

Master Car-Builders' Association.—The following circular of inquiry has been issued by the M. C. B. Committee on Car Heating:

The Master Car-Builders' Committee appointed to continue their report on the subject of Car Heating, in regard to the adoption of a Standard Coupler, beg to request the following information.

Replies to the questions herewith should be filled in, and this circular returned to F. L. SHEPPARD, Altoona, Pa., as soon as practicable.

R. D. WADE, ROB'T. MILLER, F. L. SHEPPARD, *Chairman.*

1. Name of system in use or trial. 2. Number of locomotives equipped. 3. Number of cars equipped. 4. Number of cars in train to which heat can be transmitted. 5. What is the heating medium? 6. What pressure is carried in main pipes? 7. What pressure is carried in heating pipes? 8. How is the temperature regulated, and does it require constant attention? 9. What provision is made for retaining a comfortable temperature when train is not connected to locomotive? 10. If traps are used, what kind, and where located? 11. What kind of flexible connection is used between cars? 12. What couplers are used? 13. What has been the general results with couplers and connections? 14. What have been the general results with this system of heating?

New York Railroad Club.—At the regular monthly meeting, held March 21, the President announced as the subject for discussion, "The Use of Iron in Freight Car Construction." A paper was read by G. W. EITENGER, of the Iron Car Company, of New York City. He stated that in a car constructed on correct principles, all the strains which the car has to meet would be taken up by the framework of the car below the flooring; and the box would be designed simply to protect the contents of the car from the weather, etc. Wood is continually growing scarcer and more expensive, and it is universally acknowledged that the present type of car body is far from perfect. Cars with an iron framework which have been in use are of two types. One has the frame composed of plate or rolled girders. Cars of this type have been found unsatisfactory in practical use for several reasons, among which are the difficulty in joining the horizontal to the longitudinal members of the frame; the expense of their manufacture; the difficulty of repairs; and the fact that in service the cars are too stiff, and will not yield elastically to the various shocks and blows which come to a freight car. In the other type of car, tubular iron members are used for the framework. Of cars of this type, made by the Iron Car Company, of New York, nearly 4,000 have been put into service within the past two years, and they apparently have come to stay.

A letter was read from Mr. GARSTANG, of the Chesapeake & Ohio, stating that the company had ordered 100 thirty-ton hopper coal cars of the Iron Car Co., and about three fourths of them had been received and put in service. It was too soon to give any statement of experience with them; but they carried their loads well and would be carefully tested. One car had been off the track and had some rough usage; but it came out all right.

In answer to questions Mr. EITENGER said: Our 30-ton gondola weighs from 2 to 2½ tons less than the ordinary wooden car of like capacity. There may be as much as 10 per cent. difference in the cost over a wooden car of a similar grade. We do not pretend to compete with the builders of cheap freight cars. The extra cost of the iron car is in the material used. The labor in setting up the car is about 25 per cent. less than with a wooden car of similar grade. The company is now building coal, gondola, and ordinary box cars; and proposes soon to put stock and refrigerator cars on the market. The floor is sometimes of iron, but oftener of wood bolted or riveted directly to the longitudinal beams.

In the remainder of the discussion the principal point brought out was the cost of annual repairs of freight cars and the prospect that the use of iron for framing would effect great economy in this direction. The annual cost of repairing 1,000 gondolas on the Philadelphia & Reading averaged $70 per car for 6 years. For the same period the cost of coal car repairs averaged $40 per car per annum.

One of the oldest of the iron tubular cars was run for four years on the Chesapeake & Ohio at a total cost for repairs to parts above the truck of $3.12. The car is now running on the Delaware & Hudson system.

A paper was then read and an exhibition given of the Conklin system of communication between train dispatchers and trains by means of signal boxes placed on the telegraph poles at intervals of 1,000 ft. along the line, which can be operated by the conductor and flagmen of any train when disabled or stopped for any cause.

Statistics of Railway Construction.

States East of Chicago.

(Accompanying Map No. 13 of the Progress and Prospects of Construction.)

(Concluded next week.)

In the following list, "Track laid" is during the calendar year 1888. Track laid since Jan. 1, 1889, is so noted. The terms "under contract" or "under construction" are used in some cases to denote lines on which work is not now in progress, but on which such arrangements have been made that work is likely to go on this season. "Located," "surveyed" and "under survey" are terms used to denote different stages of progress, and explain themselves. Under "projected" we have included not only those new roads for which no surveys have yet been made, but certain enterprises of longer standing on which some work has been done and which, though now at a stand-still, have some prospect of further activity.

A few projected lines in the list have been omitted from the map as not yet sufficiently matured or as having too little possibility of construction to be properly plotted there. They are included in the list, however, because of the possibility that their possession of franchises, rights of way or subsidies, or their work on portions of their proposed enterprises, may make them of direct interest to some of our readers.

Names and addresses of officers are given for the companies not included in the last issue of Poor's Directory of Railway Officials, who never we have them on our own records.

Our thanks are extended to the officials of the various companies who have furnished us the information from which the map and list have been compiled; and we especially request that any errors or omissions in either be brought to our attention.

CANADA.—Existing Roads.

Albert Southern.—Partly graded, Hopewell to Alma, 15 miles. President, W. C. Pipes, Albert, N. B.

Baie des Chaleurs.—Track laid, Nouvelle to Cascapedia, 20 miles. Under construction, Cascapedia to Paspebiac, 40 miles. Projected, Paspebiac to Gaspé, 80 miles.

1. ***Brantford, Waterloo & Lake Erie.***—Under construction, Brantford to Waterford, 17 miles. Surveyed, Brantford to Toronto, 60 miles. President, G. H. Wilkes; Secretary, J. J. Hawkins, both of Brantford, Ont.

2. ***Brockville, Westport & Sault Ste. Marie.***—Under construction, Lyn to Brockville, 5 miles.

3. ***Canadian Pacific.***—Track laid, Farnham, P. Q., to Upper Sherbrooke, 64 miles; Guelph, Ont., to Campbellville, 15.5 miles. Under construction, London to Windsor, Ont., 112 miles. Located, Harvey to Salisbury, N. B., 113 miles. Projected, Claremont to Sudbury Jct., Ont., 100 miles.

Caraquet.—Track laid, end of track to Shippegan, N. B., 9 miles.

Central Ry. of New Brunswick.—Track laid, Norton to Chipman, N. B., 42 miles.

Cumberland Railway & Coal Co.—Track laid, Spring Hill, N. S., toward Oxford, 11 miles. Track laid since Jan. 1, 1889, end of track to Oxford, 2.25 miles. Under construction, Oxford to a connection with the Oxford & New Glasgow Ry., 0.75 miles.

Drummond County.—Under construction, Drummondsville toward Nicolet, P. Q., 30 miles.

Elgin, Petitcodiac & Havelock.—Under construction, Havelock to New Canaan, 6 miles.

4. ***Grand Trunk.***—Track laid, Melocheville to Valleyfield, P. Q., 10 miles; near Lachine to Dorval, 3 miles. Projected, Waterford to Glencoe, Ont., 30 miles; Vaudreuil to Ottawa, 85 miles.

Great Eastern.—Surveyed, St. Gregoire, P. Q., to Levis, 70 miles. Contractor, C. N. Armstrong, Montreal, P. Q.

Great Northern.—Under construction, New Glasgow to Ste. Julienne, P. Q. 18 miles.

5. ***Hereford.***—Track laid, between Cookshire and International boundary, 25 miles. Track laid since Jan. 1, 1889, 1 mile. Surveyed, Stewartstown to Ayers Flat, 12 miles. Under survey, Cookshire to Quebec Central R. R., 15 miles. Chief Engineer, D. Williams, Cookshire, P. Q.

Intercolonial.—Under construction, Port Hawkesbury, N. S., to North and South Sydney, 90 miles. Graded between Oxford and New Glasgow, 30 miles; partly graded, between same points, 40 miles.

Kent Northern.—Surveyed, Kingston to Buctouche, N. B., 15 miles.

6. ***Kingston & Pembroke.***—Under construction, Tamworth to Tweed, 21 miles. Under survey, Harrowsmith to Yorker, 7 miles. Projected, Sharbot Lake to Appleton, 45 miles; Renfrew to Portage du Fort, 12 miles; Renfrew to Eganville, 23 miles; Calabogie to Darling Mines, 10 miles.

7. ***Lake Erie, Essex & Detroit River.***—Track laid, Walkerville to Ruthven, Ont., 35 miles. Under construction, end of track to Leamington, 3 miles. Chief Engineer, Joseph DeGurse, Windsor, Ont.

Lake Temiscamingue.—Under construction, Long Sault, Ont., to Kippewa Lake, 9.2 miles. Under survey, Long Sault to Mattawa, 35 miles. Emmanuel Tasse, Superintendent, Ottawa, Ont.

8. ***Leamington & St. Clair.***—Track laid, Leamington to Comber, 15 miles; Leamington to Lake Erie, 2.25 miles. President, Lewis Wigle, Leamington, Ont. (Now part of Mich. Cen. system.)

9. ***Michigan Central.***—Track laid, Niagara, Ont., to Assembly Grounds, 1 mile; Oil Springs to Edy's Mill, 2.5 miles.

Montreal & Western.—Under construction, St. Jerome, P. Q., to Chute aux Iroquois, 70 miles. Secretary, E. Rodier, Montreal, P. Q.

Newfoundland.—Track laid, Harbor Grace Junction to Placentia, 36 miles. Under contract, St. John's to Hall's Bay, 250 miles. H. C. Burchell, Colonial Government Engineer, St. John's, Newfoundland.

10. ***Niagara Central.***—Track laid, Thorold, Ont., to St. Catherine's, 5 miles. Under survey, St. Catherine's to Toronto, 70 miles. President, Dr. Lucius S. Olle; Chief Engineer, B. N. Molesworth, both of St. Catherine's.

11. ***Ottawa & Gatineau Valley.***—Projected, Ottawa to Karyabaryun, P. Q., 50 miles. Chief Engineer, W. D. Harris, 14 Metcalf St., Ottawa, Ont.

12. ***Pontiac Pacific Junction.***—Projected, Black River to Pembroke, Ont., 14 miles.

Quebec & Lake St. John.—Under construction, extensions east and west from main line, 110 miles; branch, St. Ambroise to Quebec, 12 miles.

Quebec Central.—Projected, St. Francis, P. Q. to Maine boundary line, 46 miles.

St. John & Eastern.—Under contract Buctouche, N. B., to Richibucto, 12 miles. Chief Engineer, Wm. Murdoch, St. John, N. B.

St. Lawrence, Lower Laurentian & Saguenay.—Projected, end of track to Riviere Pierre, 20 miles. President, P. E. Panneton, Three Rivers, P. Q.

13. ***South Norfolk.***—Track laid, Simcoe to Port Rowan, 17 miles. President, A. McCall, Simcoe, Ont.

Stewiacke Valley & Lansdowne.—Located, Stewiacke, N. S., to Lansdowne, 40 miles. Chief Engineer, Lionel H. Buck, Upper Stewiacke, N. S.

Tobique Valley.—Under construction, Perth Center to Plaster Rock, 28 miles. President, John B. Stewart Chief Engineer, C. L. B. Mills; both of Andover, N. B.

Western Counties.—Under construction, Annapolis, to Digby, 20 miles.

Projects and Surveys.

14. ***Berlin & Canadian Pacific Jct.***—Projected, Berlin, Ont., to Galt, 15 miles.

Brighton, Warkworth & Norwood.—Projected, Brighton to Norwood, Ont., 30 miles.

15. ***Collingwood & Bay of Quinte.***—Projected, Collingwood, Ont., to Brighton, 131 miles. Chief Engineer, Frank Moberly, Collingwood, Ont.

16. ***Cornwall Branch.***—Projected, Cornwall, Ont., to Canadian Pacific R. R., 17 miles.

17. ***Kingston, Smith's Falls & Ottawa.***—Projected Kingston, Ont., to Ottawa, 100 miles, by D. A. Givens, Geo. A. Kilpatrick, and others, of Kingston.

18. ***Ottawa, Waddington & New York.***—Projected, Ottawa to Morrisburg, Ont., 45 miles. Chas. O'Dell, President; W. J. Anderson, Vice-President; Alexander Farlinger, Treasurer.

19. ***St. Lawrence & Adirondack.***—Projected, Valleyfield, P. Q., to International boundary toward Malone, N. Y., 15 miles.

20. ***Western Ontario.***—Projected, Fort Hope to Inverhuron, 176 miles. Chief Engineer, C. W. Moberly, Toronto, Ont.

21. ***Windsor & Amherstburg.***—Projected, Windsor to Amherstburg, 12 miles.

SUMMARY.

Track Laid.

Provinces.	1888.	*Since Jan. 1'89*	*Construction.*	*Surveys.*	*Projects.*
Ontario	93.25		167	172	835
Quebec	122	10	280	97	211
New Brunswick	51.		63	128	
Nova Scotia	11.	2.25	181	40	
Total	277.25	12.25	691	437	1046

MAINE.—Existing Roads.

22 ***Bangor & Piscataquis.***—Under survey, Oldtown to Bangor, 10 miles.

Canadian Pacific—Track laid, Holeb to Mattawamkeag, 129 miles.

23. ***Dexter & Piscataquis.***—Under construction, Dexter to Dover, 16 miles. President, J. B. Mayo. Chief Engineer, D. R. Brown; both of Foxcroft.

Maine Shore Line.—Surveyed, Hancock to Calais, 93 miles; branch to Eastport, 16 miles. President J. W. Greene, Machias.

24. ***Rumford Falls & Buckfield.***—Surveyed, Gilbertville to Rumford Falls, 14.4 miles.

Shore Line Railway of Canada.—Projected, Princeton to Mattawamkeag, 55 miles. Chief Engineer, F. W. Hoit, St. George, N. B.

25. ***Somerset.***—Track laid, North Anson to Embden, 6 miles. Under construction, Embden to Bingham, 10.25 miles. Projected, Bingham to Canadian boundary, 65 miles.

Projects and Surveys.

26. ***Androscoggin Valley.***—Projected, Lewiston to Livermore, 30 miles. Rufus Prince, South Turner.

27. ***Carabasset & Canadian.***—Projected, North Anson to Canada line, 70 miles. President, W. M. Atkinson, North Anson. Chief Engineer, Henry A. Hancox, Hudson, Mass.

28. ***Castine & Bangor.***—Surveyed, Castine to Bangor 37.77 miles. President, Jas. Adams; General Manager A. M. Devereaux; both of Bangor.

29. ***George's Valley.***—Projected, Augusta to Warren, 40 miles. Irville C. Thurston, South Union, Chairman R. R. Com.

30. ***Mousam River.***—Projected, Sanford to Kennebunk, 11 miles. Geo. H. Nowell, Sanford.

Northern Maine.—Surveyed, Mattawamkeag to Presque Isle 115 miles; Houlton to Bancroft, 35 miles. President, Hon. Geo. B. Wescott, Portland, Chief Engineer, Frederic Danforth, Houlton.

Penobscot & Aroostook.—Projected, Enfield to Canadian Pacific Ry., 8 miles. President, Eugene H. Clapp, Boston, Mass. Chief Engineer, Chas. W. Mellen, Oldtown.

Phillips & Rangeley.—Projected, Phillips to Rangeley, 11 miles.

31. ***Rockland, Rockport & Camden.***—Surveyed, Rockland to Camden, 8.50 miles. President, P. J. Carleton; Treasurer, H. L. Shepherd; both of Rockport. Chief Engineer, O. H. Tripp, Rockland.

Total.—Track laid, 135 miles; Under construction, 26.25 miles; Under survey, 330 miles; Projected, 269 miles.

NEW HAMPSHIRE—Existing Roads.

32. ***Concord.***—Projected, Parker's Station to Greenfield, 17 miles; Pittsfield to Alton Bay, 15 miles.

33. ***Lake Shore.***—Under construction, Alton Bay to Laconia, 15 miles. Chief Engineer, Frank A. Merrill, Concord.

34. ***Tilton & Belmont.***—Under construction, Tilton to Belmont, 6 miles. President, Charles E. Tilton, Tilton; Chief Engineer, C. O. Foss, Concord.

35. ***Upper Coos.***—Track laid, end of track to International boundary, 2 miles.

36. ***Whitefield & Jefferson.***—Projected, Jefferson to Errol, 50 miles.

Zealand Valley.—Track laid, Zealand Notch toward Thompson Falls, 1 mile.

Total.—Track laid, 3 miles. Under construction, 21 miles projected, 82 miles.

VERMONT.—Existing Roads.

37. ***Barre.***—Track laid, Barre to Granite Quarries, 6 miles; Barre Branch R. R. 1.5 miles. Track laid since Jan. 1, 1889, Barre Branch R. R. 2.5 miles, Under survey, East Barre to quarries 1.5 miles. Projected, 1 mile. President, A. D. Morse, Chief Engineer, Ward Crosby; both of Barre.

38. ***Central Vermont.***—Track laid, Barre Junction to Williamstown, 7.4 miles. Projected, Waterbury to Stowe, 10 miles, and will be built in 1889.

39. ***Clarendon & Pittsf rd.***—Track laid, Center Rutland to Proctor, 4.5 miles. Projected, Tinmouth to West Rutland, 10 miles.

Projects and Surveys.

40. ***Rutland & Woodstock.***—Projected, Rutland to Woodstock, 20 miles. President, Rockwood Barrett; Secretary, L. G. Kingsley; both of Rutland.

Total.—Track laid, 19.4 miles; track laid since Jan. 1. 1889, 2.5 miles; under survey, 1.5 miles; projected, 66 miles.

MASSACHUSETTS. Existing Roads.

41. ***Boston, Winthrop & Shore.***—Track laid in Winthrop, 2 miles.

42. ***Grafton & Upton.***—Track laid, Grafton to West Upton, 4.6 miles. Under contract, West Upton to Milford, 8.25 miles. Chief Engineer, H. P. Bean, Grafton.

43. ***New York & Massachusetts.***—Under survey, Boston Corners to Westfield, 50 miles.

44. ***Old Colony.***—Surveyed, North Attleboro to Walpole, 11 miles.

Projects and Surveys

45. ***Haverhill & Lawrence.***—Surveyed, Haverhill to Lawrence, 8 miles. President, W. B. Thorn, Haverhill.

46. ***Plymouth & Sandwich.***—Projected, Plymouth to Sandwich, 16.5 miles.

47. ***Worcester & Hudson.***—Projected, Worcester to Boston, 44 miles. President, John Gilman, 28 Pearl St., Worcester.

48. ***Worcester & Hartford.***—Projected, East Brookfield to Hartford, Conn., 45 miles. President, John Gilman, Worcester.

Total.—Track laid, 6.6 miles; under construction, 15.25 miles; under survey, 116 miles; projected, 106 miles.

RHODE ISLAND. Existing Roads

49. ***Narragansett Pier.***—Under construction, Narragansett Pier to South Ferry, 4.50 miles.

50. ***Providence & Springfield.***—Projected, Pascoag to Webster, Mass., 12 miles.

Total.—Under construction, 4.5 miles; projected 8 miles.

CONNECTICUT. Existing Roads.

51. ***Hartford & Connecticut Western.***—Under construction, Tariffville to Springfield, Mass., 18 miles.

52. ***Housatonic.***—Projected, New Haven to New York City, 73 miles; Litchfield to Winsted, 17 miles.

53. ***Meriden & Waterbury.***—Track laid, end of track to Waterbury, 4 miles. Projected, Meriden to Wallingford, 6 miles.

54. ***New Haven & Derby.***—Track laid, Botsford to Derby, 13.34 miles.

55. ***New York, New Haven & Hartford.***—Under survey, New Britain to Farmington, 6 miles. Projected, Winsted to Lee, Mass., 28 miles.

Projects and Surveys.

New York & Boston Rapid Transit.—Located, Boston, Mass., to New Haven, 145 miles. Secretary, Wm. M. Thayer, 8 Congress St., Boston, Mass.

57. ***Rockville & Portland.***—Projected, Rockville to Portland, 30 miles. N. T. Pulsifer, Manchester.

Total.—Track laid, 17.34 miles; under construction, 11 miles; under survey, 104 miles; projected 113 miles.

NEW YORK—Existing Roads.

58. ***Allegheny & Kinzua.***—Track laid, Red House Junction to Frecks, 9 miles. President, S. S. Bullis' Chief Engineer and Superintendent, C. D. Williams; both of Olean.

59. ***Brookfield.***—Under construction, North Brookfield, to Brookfield, 7 miles. President, Wm. Stanbro, Brookfield. Chief Engineer, W. T. Randall, Oneida.

Brooklyn, Bath & West End.—Track laid, Unionville to Coney Island, 3 miles; Blytheborough to City line, 1.11 miles.

60. ***Buffalo & Williamsville.***—Under contract, Buffalo to Williamsville, 10 miles. President, B. J. Tillman, 404 Main St., Buffalo. Contractors, Crocker, Pierson & McIntyre, Buffalo.

61. ***Buffalo, Rochester & Pittsburg.***—Under construction, near Rochester to Charlotte, 6 miles.

62. ***Carthage & Adirondack.***—Track laid, Little Run to Oswegatchie, 3.5 miles. Under construction, Oswegatchie northeast, 10 miles.

63. ***Central R. R. of New Jersey.***—Under construction, Orange County R. R. Greycourt to Burnside, 10.50 miles. Chief Engineer, Everett Garrison, Newburg.

64. ***Chateaugay.***—Under survey, Saranac lake, south 10 miles.

65. ***Cooperstown & Charlotte Valley.***—Under construction, Cooperstown Junction to East Davenport, 11 miles.

66. ***Delaware & Hudson Canal Co.***—Projected, Keeseville to Port Kent, 5 miles.

4. ***Grand Trunk.***—Track laid, end of track to Massena Springs, 8 miles.

51. ***Hartford & Connecticut Western.***—Under construction, east end Poughkeepsie bridge to Silver Nail Bridge, 28 miles.

67. ***Hudson Connecting.***—Track laid since Jan. 1, 1889, Campbell Hall, north, 19 miles. Under construction to Poughkeepsie bridge, 10 miles.

68. ***Kanona & Prattsburg.***—Under construction, Kanona to Prattsburg, 12 miles. President, Martin Pinney; Chief Engineer, J. G. Baker; both of Prattsburg.

69. ***Lackawanna & Pittsburg.***—Projected, Wayland to Geneva, 40 miles.

70. ***Lehigh Valley.***—Under survey, Buffalo & Geneva R. R.—Geneva to Buffalo and Suspension Bridge, 125 miles. President of B. & G. R. R. Co., Wilson S. Bissell, Buffalo, N. Y.

71. ***Long Island.***—Under construction, Locust Valley to Oyster Bay, 4 miles.

72. ***New York & Northern.***—Track laid, Van Cortlandt to Yonkers, 3.1 miles.

73. ***New York, Ontario & Western.***—Track laid, New Berlin to Edmeston, 7 miles. Projected, Cornwall to near Fort Montgomery, 15 miles; Grahamsville to Falisburg, 10 miles.

74. ***New York, Rutland & Montreal.***—Projected, Lebanon Springs to Massachusetts State line, 12 miles.

75. ***Pennsylvania, Poughkeepsie & Boston.***—Track laid since Jan. 1, 1889, Pine Island to Augusta, N. J., 19.50 miles. Under construction, Augusta to Slatington, Pa., 58 miles. Secretary, D. J. McNiece, 35 Broadway, New York.

76. ***Port Jervis, Monticello & New York.***—Track laid, Huguenot Junction to Summitville, 17.3 miles. Surveyed, Monticello to Jeffersonville, 18 miles.

77. ***Rochester & Glen Haven.***—Track laid, Rochester to Glen Haven, 3 50 miles. Under construction, Glen Haven to Irondequoit bay, 1.50 miles. President, F. S. Minges; Chief Engineer, W. C. Gray; both of Rochester.

78. ***Staten Island Rapid Transit.***—Track laid, Clifton to Arrochar Station, 1.8 miles. Erastina to Arthur Kill Bridge, 2.2 miles.

79. ***Syracuse, Geneva & Corning.***—Track laid, Penn Yann to Crooked Lake, 1 mile.

80. ***Ulster & Delaware.***—Under construction, Hobart to Oneonta, 25 miles.

Projects and Surveys.

81. ***Columbia & Rensselaer.***—Located, Hudson to Niverville, 15 miles. John M. Pearsons, Hudson.

82. ***Fort Plain, Johnstown & Saratoga.***—Projected, Utica or Ft. Plain to Saratoga, 60 miles. Wm. Clark, Fort Plain. Alfred Dolge, Dolgeville; Geo. Streeter, Johnstown; N. E. Kernan, Utica.

83. ***Hudson Suspension Bridge & New England.***—Surveyed, Turner's Station, on N. Y., L. E. & W. R. R., to Conn. State line, with branches, 60 miles. President, Edward W. Serrell, 38 Wall St, N. Y. (Work now in progress on foundations for Hudson River suspension bridge at Fort Clinton.)

84. ***Oneida, Oneonta & New York.***—Projected, Oneida to Oneonta, 75 miles.

85. ***Oneonta & Richfield Springs.***—Under survey, Oneonta to Richfield Springs, 32 miles; branch, main line to New Berlin, 11 miles. President, A. C. Couch, Bridgewater. Chief Engineer, Chas. E. Newham.

86. ***Ossining.***—Surveyed, Whitson's Station to Sing Sing, 3.25 miles. President, John C. Cockcroft, Sing Sing. Chief Engineer, Thos. Stratford.

87. ***Rochester & Honeoye Valley.***—Surveyed, Rochester to Honeoye Falls, 16.5 miles. Chief Engineer, A. Grant Childs, Kingston.

88. ***Rome & Carthage.***—Surveyed, Rome to Carthage, 70 miles. Secretary, A. C. Kissenger, Rome.

89. ***Rome & Sylvan Beach.***—Surveyed, Rome to Sylvan Beach, 13 miles. Chief Engineer, Walter F. Randall, Oneida.

90. ***Schenectady & Ogdensburg.***—Surveyed, Schenectady to Ogdensburg, 195 miles. Secretary, Hyron Kait, 41 and 42 Wall St., New York City.

91. ***South Bethlehem & Utica.***—Under survey, Wemple's Station to Utica, 70 miles. W. H. Slingerland, Albany. Chief Engineer.

92. ***Utica, Adirondack & Saratoga.***—Under survey, Prospect to Noblesboro, 21 miles. President, H. J. Cookingham; Chief Engineer, R. W. Sherman; both of Utica.

93. ***Utica & Unadilla Valley.***—Surveyed, Bridgewater to New Berlin, 20 miles. President, A. C. Couch; Chief Engineer, Delos E. Culver; both of Bridgewater.

94. ***Washington County***—Projected, Greenwich, N. Y. to Rutland, Vt., 56 miles. President, Edward W. Serrell; Chief Engineer, J. S. Chase, both of 38 Wall St., New York City.

Total.—Track laid 60.51 miles; track laid since Jan. 1, 1889, 22.5 miles; under construction, 152 miles; under survey, 710 miles; projected, 276 miles.

NEW JERSEY. Existing Roads.

95. ***Baltimore & Ohio.***—Under construction, near Roselle to Arthur Kill Bridge, 4 miles.

63. ***Central R. R. of New Jersey.***—Projected, Point Pleasant to Lakewood, 10 miles.—Lehigh Coal & Navigation Co.—under construction, Phillippsburg to Belvidere, 12.5 miles.

96. ***Keyport.***—Under construction, Keyport to Lorillard Brick Works, 2.5 miles. President, Edward D. Adams, 120 Broadway, New York City. Chief Engineer, W. S. Sneden, Red Bank, N. J.

70. ***Lehigh Valley.***—Track laid, South Plainfield to Roselle, 10 miles.—Jersey City & Western, projected, Jersey City to Newark, 6.75 miles.

97. ***Pennsylvania.***—Track laid, near Sea Isle City to Townsend's Inlet, 1.04 miles; terminal track at Bridgeton, N. J., 1.7 miles. Projected, Medford to Mannahawken, 35 miles.—Waverly & New York Bay, projected, Waverly, N. J., to New York Bay, 6 miles.

98. ***Philadelphia & Reading.***—Surveyed, Philadelphia, Gloucester & Mt. Ephraim Ry., Mt. Ephraim to Blackwood, 7 miles. Projected, Winslow Jct. to Cape May, 35 miles.

99. ***Raritan River.***—Track laid, South Amboy to South River, 7 miles. Under construction, South River to Bound Brook, 13 miles. President, Edward H. Ripley. Chief Engineer, E. W. Harrison, Fuller Building, Jersey City.

100. ***Rockaway Valley.***—Track laid, White House to New Germantown, 4.5 miles. Projected, New Germantown to Montclair, 30 miles. Chief Engineer, J. V. Melick, White House.

101. ***Williamstown & Delaware River.***—Track laid, Glassboro to Mullica Hill, 6.8 miles.

Projects and Surveys.

102. ***Barnegat Park.***—Under construction, Barnegat Park Station to Barnegat Bay, 2 miles. President, John B. Larner, Washington, D. C. Secretary, Wm. L. Bruen, Barnegat Park.

West Side Connecting.—Under survey, Jersey City to Bayonne, 7 miles. President, Geo. W. H. Helme; Chief Engineer, Frank H. Earle, both of Jersey City.

Total.—Track laid, 31.04 miles; track laid since Jan. 1 1889, 16 miles; under construction, 62 miles; under survey, 14 miles; projected, 123 miles.

DELAWARE.—Existing Roads.

97. ***Pennsylvania.***—Track laid, junction with the New Castle & Wilmington R. R. to a junction with the Philadelphia, Wilmington & Baltimore R. R., 5.51 miles; Edgemoor to north of Newport, Del., 5.3 miles.

Projects and Surveys.

103.—***Georgetown & Milton.***—Projected, Georgetown to Milton, 8 miles.

MARYLAND.—Existing Roads.

104. ***Baltimore & Drum Point.***—Under construction, Baltimore to Drum Point, 80 miles. Under survey, Conaway's, 20 miles south of Baltimore, to Washington, D. C., 20 miles. President, Augustus Albert; Chief Engineer Nicholas Goldsborough, 10 South St., Baltimore.

105. ***Baltimore & Eastern Shore.***—Surveyed, Annapolis to Salisbury, 54 miles. President, Jos. B. SETH, Easton.

95. ***Baltimore & Ohio.***—Track laid, Carroll's Station to Clifford's, 2 miles. Under survey, branch to Baltimore & Sparrow's Point R. R., 2 miles.

106. ***Baltimore & Sparrow's Point.***—Track laid, Colgate Creek to Sparrows Point, 4.5 miles.

107. ***Deer Creek & Susquehanna.***—Under contract, Belair to Stafford, 16 miles. President, George M. Jewett, Churchville, Md.

108. ***Western Maryland.***—Surveyed, Westminster to Manchester, 7 miles.

Projects and Surveys.

109. ***State Line & Oakland.***—Under survey, Confluence, Pa., to Oakland, Md., 45 miles. Chief Engineer, J. U. Crawford, Fox Chase, Philadelphia, Pa.

110. ***Washington & Great Falls.***—Projected, Great Falls to Washington, D. C., 15 miles. M. F. Morris, Washington, D. C.

Total.—Track laid, 6.5 miles; under construction, 90 miles; under survey, 113 miles; projected, 15 miles.

PENNSYLVANIA.—Existing Roads.

58. ***Alleghany & Kinzua.***—Track laid, Smith's Junction to Coffey Run, 11.25 miles.

111. ***Bangor & Portland.***—Under construction, Pen Argyle to Wind Gap, 2.5 miles.

112. ***Beech Creek.***—Projected, Phillipsburg west, 12 miles.

113. ***Bloomsburg & Sullivan.***—Track laid, Benton to Junction City, 10 miles. Superintendent, F. M. Leader, Bloomsburg.

63. ***Central R. R. of New Jersey.***—Track laid, Minooka to Scranton, 4 miles.

114. ***Clearfield & Jefferson.***—Track laid, West Eureka, No. 2 westward, 5 miles. Track laid since Jan 1, 1889, end of track to West Eureka, No. 3, 1.25 miles. Under survey. West Eureka, No. 3 to Whitesville, 6 miles.

115. ***Cornwall.***—Under survey, Cornwall to Lancaster, 18 miles; Cornwall to Middleton, 18 miles.

116. ***Cornwall & Lebanon.***—Surveyed, Lebanon to Reading, 25 miles.

117. ***Johnsonburg.***—Under construction, Clermont to Johnsonburg, 20 miles. Chief Engineer, Edwin H. Welch, Rolfe.

Lehigh Valley.—Track laid, Fairview to Pittston, 17.2 miles; Mahanoy City to Barry's 2.5 miles; Loyalsock R. R. extension, 3 miles.

118. ***Lehigh & Lackawanna.***—Track laid, Wind Gap to Saylorsville, 5 miles. Under construction, Pen Argyle to Stroudsburg, 15 miles.

119. ***McKeesport & Belle Vernon.***—Track laid, McKeesport to Elizabeth, 8 miles. Under construction, Elizabeth to Belle Vernon, 18 miles. President, J. Wainwright, McKeesport.

120. ***New York, Lake Erie & Western.***—Newcastle & Shenango Valley, track laid, to New Castle to West Middlesex, 16 miles. Moosic Mountain & Carbondale, projected, Carbondale Dunmore, 16 miles. Honesdale Branch, Honesdale to Thompsons, 30 miles.

73. ***New York, Ontario & Western.***—Under construction, Hancock, N. Y., to Scranton, Pa., 45 miles.

97. ***Pennsylvania.***—Track laid, Cambria & Clearfield Ry., San Jose to Brubaker Jct., 9.4 miles, St. Lee branch, 0.5 miles.—King's Run branch, 1.4 miles.—Brubaker branch, 6 miles Under construction, Latrobe to Lippincott and Whitney, 15 miles; Ninick Station to Woods Run Station, 2.25 miles. Projected, Butler to Newcastle, 25 miles; New Holland to main line, 10 miles.

121. ***Perry County.***—Under construction, New Bloomfield to Duncannon, 11 miles. President, Frank H. Mortimer, New Bloomfield.

98. ***Philadelphia & Reading.***—Under construction, near Rupert to Bloomsburg, 2 miles; point on Lehigh & Susquehanna R. R. to a point in Allentown, 3 miles. Projected, Hartsville to New Hope, 12 miles.

122. ***Pittsburg & Lake Erie.***—Projected, Fallston, Pa., north, 2 miles.

123. ***Pittsburg, Shenango & Lake Erie.***—Track laid, Greenville to Osgood, 4 miles. Under construction, Osgood to Conneaut, O., 45 miles.

124. ***Turtle Creek Valley.***—Under construction Stewarts to Murrayville, 6 miles. Surveyed, Murrayville to Saltsburg, 17 miles. J. M DuBarry, President; Chas. Paine, Chief Engineer, Philadelphia.

125. ***Warren & Farnesworth.***—Projected extension to Balltown, 10 miles.

108. ***Western Maryland.***—Track laid, Ortanna to Fairfield, 4.1 miles. Under construction, end of track to State line, 10 miles. Projected, Porter's to York, 14 miles.

126. ***Wilkesbarre & Western.***—Projected, Millville to Shickshinny, 20 miles.

127. ***Williamsport & Binghamton.***—Under construction, Williamsport, Pa. to Binghamton, N. Y., 110 miles. President, Francis M. Ward, Newton, N. J.; Chief Engineer, P. E. Alden, Monroeton, Pa.; Contractors, Belden & McTighe, 52 Broadway, New York City.

Projects and Surveys.

128. ***Beech Creek & Hudson River.***—Projected, Newberry to Turbotsville, 26 miles. R. C. Belville, Trenton, N. J.

129. ***Coudersport, Hornellsville & Lackawanna.***—Under survey, Coudersport, Pa. to Hornellsville, N. Y., 55 miles. Chief Engineer, C. H. Wickham, Hornellsville, N. Y.

130. ***Emporium & Williamsport.***—Projected, Emporium to Williamsport, 65 miles.

131. ***McKeesport & Bessemer.***—Projected, McKeesport to a point near Belle Vernon, 4 miles

132. ***Middletown & Hummelstown.***—Under contract, Middletown to Hummelstown, 6 miles. President, John W. Rife; Secretary, C. W. Raymond; both of Middletown.

133. ***Penn Mountain Switchback.***—Surveyed, gravity road around Penn Mountain, near Reading, Pa., 5 miles. Thos. P. Merritt, Reading.

134. ***Pittsburgh, Cannonsburg & State Line.***—Surveyed, Pittsburgh, to West Virginia State line, 40 miles. President, J. B. Donaldson, Cannonsburg, Pa. (See also Wheeling, Wellsburg & State Line in West Virginia.)

135. ***South Mountain.***—Projected, Harrisburg to Slatington, 8 miles.

136. ***Schuylkill & Lehigh Valley.***—Under construction, Bowman's Station to Tremont, 50 miles. President, Eaton N. Friable, 1 Broadway, New York City.

137. ***Titusville, Cambridge & Lake Erie.***—Projected, Pleasantville to Erie, 65 miles. President, A. H. Steele, Chief Engineer, F. P. James; both of Titusville.

138. ***West Chester & Lenape.***—Projected, West Chester to Lenape, 4 miles. Chief Engineer, F. L. Hills, Wilmington, Del.

Total.—Track laid, 102.9 miles; track laid since Jan. 1, 1889, 1.25 miles: under construction, 302 miles; under survey, 169 miles; projected, 400 miles.

RAILWAYS.

EAST OF CHICAGO—Existing Roads.

Jones Mountain.—The President of this company, FRED. W. JONES, of Jonesburg, Columbia Co., N. Y., sends us the following:

This railroad is projected to extend from Hudson to Quarryville, about 15 miles. The surveys are made and about 4 miles of track have been laid, on which cars are now running. Grades between Hudson and Jonesburg are 120 to 180 ft. per mile, the remainder of the line will not be over 60 ft. per mile. It is expected that the whole line will be completed in about one year. The road will secure a traffic from stone quarries and cotton and woolen mills, with some farm products. WM. YOUNG is Chief Engineer.

Williamsport & Binghamton.—At a meeting of the directors, held at Williamsport, Pa., March 19, it was voted to push construction at once on the 24-mile section between Williamsport and Barbour's mills, on the 28-mile section from Barbour's mills north, and on the 10-mile section north from Appalachian.

Penn's Mountain.—Contracts have been let for this 5-mile gravity road at Reading, Pa., JOS. GANSER, of Reading, is President.

Evansville & Terre Haute.—A surveying corps have begun work at Richmond, Ind., on the northern division of the Evansville & Richmond Ry.

Hartford & Connecticut Western.—The proposition before the Connecticut Legislature to permit this company to issue bonds to the amount of $2,000,000 is meeting with strong opposition at Hartford; and the Springfield & Connecticut extension, now under construction from Tariffville to Springfield is denounced as an attempt to "side track" Hartford. The report that a consolidation was arranged for, by a charter secured in Delaware last week, of the 5 companies whose lines of railway united will extend from Slatington, Pa., to Springfield, Mass., has done much to strengthen this opposition.——It is stated that a project is now under way for an extension from Hartford to Worcester, Mass., via Leicester, Spencer, East Brookfield, Brimfield, and Rockville. Meetings to arouse public interest and secure local aid are now being held along the proposed route.

Pennsylvania.—It is stated that surveys have begun for a cut off from Bristol via Morristown to some point west on the main line, a total distance of about 60 miles, which will be used principally for through freight between New York and the West, saving in distance 7 miles and avoiding the crowding of the local freight traffic in the Philadelphia yards.——Work is soon to begin on the extension of the Dowingtown & Lancaster Railway from the present terminus to the main line.

The annual meeting of the Pittsburg, Cincinnati & St. Louis Co. was held at Columbus, O., March 19. The report for 1888 shows net earnings of $344,839, a decrease from 1887 of $478,235. The result including all lines operated is a deficiency of $95,254.74, against a surplus for 1887 of $602,947.43. The expenditure during the year on betterments, but charged to operating expenses, was $486,-112.96. This includes the completion of the second track between Pittsburg and Mingo, as well as about 86 miles of new second track between Columbus and Newark.

Surveys have been made for a branch from the Indianapolis & Vincennes Ry. to stone quarries near Stinesville, Ind.

Rockaway Valley.—The contract is to be let at once for the extension of this New Jersey road from New Germantown to Pottersville, about 4 miles. J. E. MELICK, Whitehouse, N. J., is Chief Engineer.

Central Railroad of New Jersey.—The report of this company for 1888, just received, shows as follow:

	1888	Increase
Gross earnings	$13,177,472	$1,752,798
Operating expenses and taxes.	7,204,067	778,798
Net earnings	5,973,405	964,259

The gross earnings were the largest in the history of the company. During the year $1,937,967 was expended in repairs and maintenance of roadway and equipment, and was charged to operating expenses. The company now operates 627 miles of railway lines, and 33 miles of steamer and ferry lines.

It is reported that the Baltimore & Delaware Bay railroad is to be extended from Chestertown, Md., to Tolchester about 7 miles.

Intercolonial.—It is proposed to extend the Cape Breton, Ry., now under construction from Canso to Sydney, N. S., to a terminus at the historic port of Louisburg, the harbor of which is said to be always free from ice and is therefore well adapted for use as a winter port.

Frankfort & Southeastern.—This Michigan company will build an extension to a junction with the Manistee & Traverse City R. R. early in the spring; the Toledo, Ann Arbor & North Michigan R. R. will probably build a branch to the same point.

Cincinnati, Hamilton & Dayton.—The recent report from Cincinnati, which depicted a probable consolidation of the lines of this company, the Dayton, Fort Wayne & Chicago, the Wheeling & Lake Erie, and the Toledo, St. Louis & Kansas City, received little credence here. Officers interested in the roads in question explicitly denied the reports; and the condition of the several companies is such that a consolidation seems very improbable

Projects and Surveys.

Mousam River.—Incorporated in Maine by ERNST M. GOODALL, CHARLES H. FROST, GEORGE H. NOWELL, and others to build a line of railway from a point near Springville, Me., through the towns of Alfred, Lyman, and Kennebunk to a point at or near the village of Kennebunk, Me., about 11 miles.

Michigan City & Valparaiso.—It is stated that a project is being agitated by the citizens of Michigan City, Ind., to build a railway from that place to Valparaiso, Ind., a distance of about 18 miles.

Charlotte & Braddock's Bay.— A press report states that the old project to build a railway from Charlotte, N. Y., to Braddock's bay, a distance of 7½ miles, has been revived and a new charter secured. It is probable that unless the New York Central & Hudson River R. R. will lease and operate the road as a portion of their Charlotte branch, the new road will be operated by electricity. Among the incorporators are JOHN A. DAVIS, JAMES D. CASEY, J. M. KELLEY, and others of Rochester, N. Y.

Hornellsville & West Union.—Incorporated in New York to build a line of railway from the New York, Lake Erie & Western via Hornellsville, Canistee and Greenwood to a connection with the Coudersport, Hornellsville & Dackawanna R. R., a distance of 16 miles.

Amherstburg, Lake Shore & Blenheim.—A bill has passed the Ontario Legislature incorporating a railway company by this name.

Buffalo, Lackawanna & Pacific.—Incorporated in New York to build a line of railway from the Grand Trunk yards in Buffalo to a point on the river below Niagara Falls, about 12 miles. The officers are; President, JOSEPH RICHARDSON, of New York; Vice-President, JAMES R. SMITH, of Buffalo; Treasurer, C. B. GASKELL, Niagara Falls; Secretary, C. M. HOWE, of Buffalo; and General Manager, J. E. MCINTIRE, of Buffalo.

Windsor & Amherstburg.—W. D. BALFOUR, Member Canadian Parliament for South Essex, has resigned because the Government refused to grant a subsidy to this enterprise.

Ohio Falls.—Incorporated in Indiana to build a railway from New Albany to Jeffersonville, about 4 miles. Among the incorporators are W. N. MARSHALL, W. H. FOGG, PAUL REISING, and O. A. CLARK.

Sandy Hill Quarry.—It is stated that the Sandy Hill Quarry Co. (offices, Sandy Hill, N. Y.) contemplates building a railway from its quarries to the Delaware & Hudson R. R. Surveys have been made and work is to begin soon.

SOUTHERN—Existing Roads.

Louisville, Hardinsburg & Western.—Mr. J. C. FAWCETT, of Louisville, Ky., writes us as follows:

The surveys are completed for this road, which is to run from Irvington via Garfield, Hardinsburg and Falls of Rough to Fordsville, a distance of 40 miles. The work is light, and grades and curves easy. There will be one tunnel of 300 ft. The principal business will be the transportation of timber, coal, stone and farm products. All of the right of way has been secured and $60,000 of bonds have been subscribed by the Breckenridge Co. The contract for construction has been let to Marshall Morris & Co., of Louisville, Ky., and the road is expected to be open for traffic by Oct. 1, 1889. The company was incorporated Feb. 24, 1888. B. F. BEARD, of Hardinsburg, Ky., is President, and C. L. CORNWELL, of Louisville, Ky., is Chief Engineer.

Alabama Midland.—Grading will be completed between Bainbridge and Ozark, 85 miles, by May 1. The Northwest & Florida R. R. is now controlled by this company, and it is stated that the gauge will be made standard immediately.

Alabama & Vicksburg.—The purchasers of the Vicksburg & Meridian R. R. have organized a new company and changed the name to the Alabama & Vicksburg Railway. The following are the officers of the new company: President, CHARLES SCHIFF, of Cincinnati, O.; Vice-President, C. C. HARVEY, and Secretary and Treasurer, H. H. TATEM.

Eutawville.—A large part of the grading between Eutawville and Summerville, 15 miles, is completed. The bridge across the Santee river has been repaired and is now open to construction trains, and work is in progress on the trestle over the Santee swamps. H. T. PEAKE, of Vance, S. C., is Chief Engineer.

Tennessee Midland.—The president's annual report to the stockholders shows that this road can be completed to the Virginia State line at a cost of $17,000 per mile. The line has already been surveyed from the Tennessee river to Nashville, and it is stated that construction will be pushed. JOHN OVERTON, of Memphis, Tenn., has been elected President to succeed A. S. BUFORD.

Tuscaloosa & Northern.—Tuscaloosa, Ala., has given this road the $85,000 originally subscribed to the Memphis & Atlantic R. R. It is stated that work will begin at once. The road is projected to run from Tuscaloosa to a connection with the Kansas City, Memphis & Birmingham R. R. R. C. MCCALLA, of Tuscaloosa, is President.

Atlantic Coast Line.—It is thought that this company will extend the line, now under construction between Scotland Neck and Kinston, to Wilmington.—The company has offered to build a line to Brinkleyville, 12 miles, if the citizens will raise $14,000.

Louisville, New Orleans & Texas.—Garvey Bros. & Kelly, of Memphis, Tenn., have the contract to build the 17½ mile branch from Slaughter, La., to Bayou Sara on the West Feliciana R. R. It is stated that surveys are in progress for an extension of the Bolivar branch to either Bobo or Coahoma, in Mississippi. A branch is also projected from Rolling Fork, Miss., to Hampton, Miss., a distance of about 10 miles.

Projects and Surveys.

Guntersville, Fort Payne & Chattooga Valley.—Organized in Alabama to build a line of railway from Guntersville to Fort Payne, a distance of about 32 miles. The officers are: President, L. A. DOBBS; Secretary and Treasurer, HENRY B. CAMPBELL, both of Fort Payne, Ala.

Bowling Green & Northern.—The locating surveys for this road are reported in progress, and work on construction will commence soon.

Gulf & Chicago.—This project to build a line of railway from Mobile, Ala., north to the Tennessee river, a distance of about 300 miles, is again being agitated. A new charter has been obtained.

Alabama & Texas.—This company has been chartered in Alabama to build a railway from Montgomery through the counties of Lowndes, Wilcox, Clark and Choctaw to the Mississippi State line, a distance of about 150 miles.

Virginia & Kentucky.—Organized in Virginia with DAVID S. PIERCE, of Wytheville, as President, to build a line of railway through the counties of Wythe, Carroll, and Bland at right angles to the Norfolk & Western R. R.

Anniston & Montgomery.—It is stated that this company will begin construction on their road, which is projected to run from Anniston to Montgomery, a distance of 110 miles, about the first of May and will rapidly push the road to completion. C. C. WRENSHALL, of Anniston, Ala., is Chief Engineer.

Paducah & Tennessee.—The contract for building 100 miles of this road has been let to McIntyre & Concannon, of St. Louis, Mo. THOS. H. PURYEAR, of Paducah, Ky., is President.

THE NORTHWEST—Existing Roads.

Keokuk & Western.—The second annual report of this Iowa road shows as follows:

Gross earnings	$328,546
Total expenses	234,705
Net earnings	93,841

President F. T. HUGHES says that the rates of the road have been cut down because of the recent State legislation; and he doubts whether the receipts obtainable under the present tariff, as fixed by the Commissioners, will be more than sufficient to maintain and operate the roads as they are at present, to say nothing of paying interest on the capital invested.

Duluth & Winnipeg.—The bill before the Minnesota Legislature, giving this company a land grant of large amount in the northern part of the State, was finally defeated in the Senate.

Cairo, Vincennes & Chicago.—General Manager MCDONALD states that the bondholders of this Illinois company will probably dispose of the road to whoever will pay the highest price, if a fair sum can be secured. Whether the road will form part of the Vanderbilt system or the Pennsylvania he thinks is not decided, and is not likely to be till after the reorganization which occurs on April 25.

Projects and Surveys.

Springfield, Shelbyville & Mt. Carmel.—It is stated that the survey for this line is to be continued from Springfield, Ill., to Evansville, Ind. The line was projected to run from Effingham to Springfield, Ill., a distance of 82 miles. A. B. FITCH, of Terre Haute, Ind., is Chief Engineer.

Duluth, Crookston & Northern.—This company, which proposes to build a line of railway from a point near Duluth to Crookston, with branches from Crooks-

ton, west to the Red river and southeast to Brainerd, has elected the following officers: President, R. J. MONTAGUE; Vice-President, JOHN MCLEAN; Secretary, E. M. WALSH, and Treasurer, WM. ANGLIM.

Western Transcontinental.—A bill is before the British Columbia Legislature chartering a company by this name to build a line of railway from Victoria, B. C., via Pete Jaunce, Caiche, Cariboo, Chilcoten, and Butte Inlet to Winnipeg. This is stated to be a link of a great transcontinental line, which will follow a route originally laid out for the Canadian Pacific, but further north than the line finally adopted. The incorporators are local capitalists.

THE SOUTHWEST—Existing Roads.

Omaha, Dodge City & Southern.—This company has purchased the Dodge City, Montezuma & Trinidad R. R., which is now in operation from Dodge City to Montezuma, Kan., a distance of 28 miles, and will extend it through Ulysses, Grant and Stanton City to Trinidad, Col. A branch is also projected from Riverside or McCracken southwest to Ravenna or Gordon City. G. M. HOOVER, of Dodge City, Kan., is President.

Hot Springs Branch.—It is stated that this road, which runs from Malvern, Ark., to Hot Springs, Ark., 25 miles, is to be changed to standard gauge.

San Antonio & Aransas Pass.—At a recent meeting of the directors of this road, the President was authorized to put under construction all extensions of the road projected, including those from Comfort to Llano, from Shiner to Austin, from West Point to Waco, from Kennedy to Laredo, and from Houston to Shreveport, La., a total mileage of about 700 miles. The Llano extension is already under contract.

Projects and Surveys.

Brazos Terminal.—Incorporated in Texas by WILLIAM D. LEE, of Leavenworth, Kan., and others, to build a railway between Velasco and Quitman, near the mouth of the Brazos river, and form connections with the projected deep-water port at that point.

Larned & La Crosse.—A company has been organized in Kansas to build a railway from Larned to La Crosse, a distance of about 30 miles.

ROCKY MT. AND PAC.—Existing Roads.

Salem, Tillamook & Astoria.—Construction has begun at the western end of this road, which is to run from Salem, Ore., to Astoria, Ore., a distance of 120 miles. JOHN G. WRIGHT and J. A. MANNING, both of Salem are interested.

San Francisco & North Pacific.—At a recent meeting of the stockholders of the San Francisco & North Pacific R. R. the several branches were consolidated into a new corporation to be known as the San Francisco & North Pacific Railway Co.

Union Pacific.—It is stated that if the proposed consolidation of the Utah Central R. R. with the Union Pacific is successfully opposed by the stockholders of the former, that the Union Pacific will immediately broaden the gauge of the Utah & Nevada and extend it west dividing in Nevada, with one line going to Los Angeles and the other to San Francisco.——It is announced that the Cheyenne & Northern Ry. in Wyoming will be extended from its present terminus at Wendover to Fisher Station on the Fremont, Elkhorn & Missouri Valley R. R., a distance of 32 miles.

Nevada & California.—It is expected that this company will resume construction, north from Reno, Cal., soon.

Tacoma, Olympia & Chehalis Valley.—It is announced that grading has begun on a portion of this road, which is to run from some point on Gray's Harbor east to some point on the Columbia river, in eastern Washington, with a branch line to Tacoma. It is the intention of the company to push the construction of the road east into the coal fields as soon as possible. WM. R. MARSHALL, of St. Paul, Minn., is interested.

Fairhaven & Southern.—NELSON BENNETT, of Tacoma, W. Ter., President, has sent us the following information:

This road is to be a north and south line from the International boundary via Fairhaven to the Oregon State line, a distance of 250 miles. Thirty miles of this has been located and is now under construction. The work is heavy; grades have been limited to 2 per cent. and curves to 10°. A 2,000 ft. bridge with draw will be required at the crossing of the Skagit river. The business of the road will be in the transportation of timber, coal and iron and general traffic. The funds for construction are furnished by the projectors of the company, they taking full paid stock therefore. Tracklaying will begin about July 1, and it is expected to have the 30 miles now under construction completed by Jan. 1, 1889. We have contracted for rails, fastenings, etc., and two 10-wheel locomotives are in course of construction. The company was incorporated Nov. 27, 1888. J. J. DONOVAN, of Fairhaven, is Chief Engineer and E. M. WILSON, of Tacoma, is Vice-President.

Montana Central.—A press report states that surveyors are at work on the proposed branch line from Great Falls, Mont., to the mining camps in the Belt Mountains, about 40 miles.

Oregon & Washington Territory.—Work on the branch from Walla Walla, W. Ter., to Dayton will begin about April 1. J. O. MARTIN, of Walla Walla, is contractor.

Esquimault & Nanaimo.—A project is being discussed for the extension of this road to the northern coast of Vancouver Island, a distance of 175 miles, and the construction of a road from Portland, Ore., north to the Straits of Juan de Fuca, a distance of about 210 miles, making a short line between San Francisco and Sitka.

Projects and Surveys.

Denver, Rocky Mountain & Western.—Incorporated in Colorado to build a line of railway from Denver via Morrison to Mount Evans. Among the incorporators are THOS. L. WISWALL, FRANK DUGGAN, JULIUS C. DEDISSE and others of Denver, Col.

Concord & Seal Bluff.—It is reported that a railway is to be built from Concord, Contra Costa county, Cal., to Seal Bluff in the same county. It is estimated that it will cost about $45,000.

Northwestern & Lake of the Woods.—A bill is before the Canadian Parliament incorporating a company by this name to build a railway from West Lynne, Mont., to Portage la Prairie, and from Rosenfeld Junction via Brandon to Harrowby, with branches from Brandon to a point on South Antler Creek, and from West Lynne to Lake of the Woods. Among the incorporators are J. R. BOOTH, of Ottawa, A. W. OGILVIE, and W. GREER, of Montreal.

New Westminster & Vancouver.—ROBERT DICKINSON and HENRY HOY, of New Westminster, B. C., and THOS. DUNN and R. G. TATLOW, of Vancouver, B. C., have applied for a charter to build a line of railway from New Westminster to Vancouver, about 7 miles.

RAPID TRANSIT.

Electric Railways.—*Beverly, Mass.*—Work is in progress on the Beverly and Danvers electric line, and it is expected to be completed by June.

Buffalo, N. Y.—The East Side Street Ry. Co. has decided to adopt an overhead wire electric system.

Red Bank, N. J.—An electric railway to Seabright is projected. W. T. COBLIES, of Red Bank, and CHAS. H. WHITE, of New York, are interested.

Alliance, O.—The electric railway has been opened for traffic.

Grand Rapids, Mich.—The Grand Rapids Street Ry. Co. proposes to adopt some electric system this season.

Lake, Ill.—The Lake, Hyde Park & Calumet Street Ry. Co. has applied for a franchise for an electric line.

Eau Claire, Wis.—The street railway company has awarded a contract to the Sprague company for the equipment of its line with the Sprague electric system.

Sioux City, Ia.—The street railway company has been granted a franchise for 50 years to operate its line by electricity. Mr. PRAVEY is president of the company.

Denver, Col.—The Denver Tramway Co. will build an electric line about a mile long from the terminus of its cable road at the railway crossing on Broadway.

Cable Railways.—*Peoria, Ill.*—The Peoria Cable Ry. Co. has been incorporated by VALENTINE JOBST, J. DOHENY, and G. B. FOSTER. Capital stock, $400,000.

Sioux City, Ia.—The cable line is expected to be in operation by May. Mr. PHOENIX is the contractor.

Denver, Col.—The Denver City Cable Ry. Co. will extend its line on Colfax Ave. if a subsidy of $150,000 is granted.

Street Railways.—*Randolph, Mass.*—The Selectmen have decided to grant a franchise to the street railway company.

New York, N. Y.—The Metropolitan Cross-Town Ry. Co. has been incorporated by WM. CARROLL, CALVIN C. CAMPBELL, H. L. KINGSBURY, and others. Capital stock $300,000.

Joliet, Ill.—The Joliet Street Ry. Co. has been organized by J. A. HENRY, G. J. MONROE, and J. W. FOLK. Capital stock, $150,000.

La Crosse, Wis.—The La Crosse & Onalaska Street Ry. Co. has been organized by JAMES B. CANTERBURY, GEO. L. KINGSLEY, and E. B. MAGILL.

Pueblo, Col.—The Pueblo Rapid Transit & Circle Ry. Co. has been incorporated by WILLIAM CROOK, J. B. ORMAN, A. E. GRAHAM, and others. Capital stock, $100,000.

Denver, Col.—The South Denver Street Ry. Co. has been incorporated by CHARLES L. MCINTOSH, S. V. FARNUM, and J. L. KILLILAND. Capital stock, $75,000.

Houston, Tex.—The Houston St. Ry. Co. has transferred three-fourths of its stock to the Chicago syndicate headed by Mr. HOLMES, of the Chicago City Ry. Co.——The new street railway being built by Boyd Bros. is progressing rapidly. Mr. BREEDLOVE is the engineer.

Dummy Lines.—*Sweetwater, Tenn.*—A dummy line is to be built to Madisonville.

Montgomery, Ala.—The Capital City Street Ry. has been acquired by a syndicate headed by Mr. I. POLLAK; the lines are to be operated by dummy engines.

Denver, Col.—Leonard & Montgomery and Donald Fletcher will build a dummy line 2 miles long at a cost of $100,000.

Portland, Ore.—The Sunnyside motor line is to be extended and several new motor lines are projected.

CONTRACTING.

New Croton Aqueduct.—The Aqueduct Commissioners have accepted Section No. 13, built by John Brunton, & Co., and Section No. 13 A, built by O'Brien & Clark. On the report of Chief Engineer FTELEY that there are spaces around the aqueduct, into which broken rock may fall and injure the structure, it was decided that the spaces should be filled with grouting at a cost of not more than $5,000. The contract for clearing the site of the projected reservoir, on the east branch of the Croton river and Bog brook, of trees and undergrowth, was awarded to Pennell, O'Hare & Co., for $8,975.

Supplies.—The following contracts have been awarded by the Docks Commissioners, New York City:—John A. Bouker: $1.80 per cu. yd. for 500 cu. yds. of broken stone. A. J. Murray: $2 each for 724 crib logs 35 to 40 ft. long; $1.30 each for 1,068 crib logs 30 to 35 ft. long. Ward & Olyphant: egg and nut coal, $4.25 and $5.35 per ton. For 30 day's service of 8-in. steam pump, with appurtenances, John Baxter bid $20 per day, Chapman Derrick & Wrecking Co., $22 per day.

The Road Committee, Montreal, has awarded contracts as follows: Tamarac floats, G. A. Grier, 7¼ cts. per ft.; yellow pine lumber, A. S. Lemay, $34.50 per M.; cement, W. McNally & Co., for 750 bls. Johnson's brand, at 7½ cts. per 100 lbs.; and to W. & F. P. Currie & Co., for 250 bls. of brand C. F. Z. W. N. Z., at 17½ cts. per 100 lbs.

Lighter.—The following proposals for building a lighter for the James river improvement work were received March 19, by Col. WM. P. CRAIGHILL, U. S. Engineer Office, Richmond, Va.: H. T. Morrison & Co., Petersburg, Va., $1,476.50; Geo. W. Donly, Richmond, Va., $1,650; Chas. Reeder & Sons, Baltimore, Md., $2,645: Wm. E. Woodall & Co., Baltimore, Md., $3,000. The contract was awarded to H. T. Morrison & Co. The lighter will be 68 ft. x 28 ft. on deck, and 60 ft. x 27 ft. on the bottom, with total outside depth of 6 ft.

Dump Scows.—The following proposals for building 3 dump scows, of 200 cu. yds. capacity each, were opened March 5 by Capt. T. L. CASEY, U. S. Engineer Office, New York City: A. J. Beardsley, Stratford, Conn., $4,850 each, $14,550. James D. Leary, New York, $5,490 each, $16,470. Trundy & Murphy, Brooklyn, N. Y., $5,700 each, $17,100. Timothy Desmond, Hoboken, N. J., $10,000 each, $30,000. The lowest bid, that of A. J. Beardsley, could not be accepted because of a clause extending the time for completion of the work beyond that stated in the specifications, and the contract was therefore awarded to J. D. Leary, the next lowest bidder.

Timber.—The following proposals for timber for the LaGrange dam, Illinois river improvement, were opened March 20 by Capt. W. L. MARSHALL, U. S. Engineer Office, Chicago, Ill.: C. Crane & Co., Cincinnati, O.: $32.50 per M. for 268,788 ft. B. M. of white oak timber, $35 per M. for 162,360 ft. B. M. of white oak plank, $14,418.21 total. Wm. Towle & Co., Metropolis, Ill.: $34, $37, $15,146.11. A. & F. Zeitinger, Zeitonia, Mo.: $35.80, $37.80, $15,759.82. R. B. Stone Lumber Co., Chicago, Ill.: $9,551.67 and $6,819.12 for the lot, $16,371.09. Hatch & Keith, Chicago, Ill.: $37, $43.50, $17,007.82. T. W. Harvey Lumber Co., Chicago, Ill.: $37, $43.50, $19 per M. for 105,000 ft. B. M. of white pine timber, $19,002.82. Ohio Valley Tie & Lumber Co., Chicago, Ill.: $27 for white oak timber, $7,257.28.

Lumber.—The following proposals for furnishing 426,000 ft. B. M. of creosoted yellow pine have been received by the Docks Commissioners, New York City: Eppinger & Russel, New York, $34.25 per M.; Creosoting Lumber & Construction Co., Fernandina, Fla., $35.50; Old Dominion Creosoting Co., Norfolk, Va., $35.95; Carolina Oil & Creosoting Co., Wilmington, N. C., $36.20. The contract was awarded to Eppinger & Russell.

The following proposals for furnishing lumber have been received by the Harbor Commissioners, San Francisco, Cal.: S. E. Slade & Co., $16.75, $17.25 and $19.25 for up to 40 ft., 41 to 50 ft. and 51 to 60 ft., for 6 months; $18, $19 and $21 for 12 months. Pacific Pine Lumber Co., $16.50, $17.50, $19.50 for 6 months, $17.25, $18.75 and $20.75 for 12 months. Kennedy & Shaw Lumber Co., $16.65 and $17.75 for 40 and 50 ft. for 6 months; $17.90 and $18.90 for 12 months. Simpson Lumber Co., $17 and $18 for 6 months; $18 and $19 for 12 months. S. H. Harmon Lumber Co., $16.95 and $17.95 for 6 months; $18.25 and $19.25 for 12 months. All the bids were rejected and the work readvertised.

Dredging and Stone.—The following proposals were opened March 19 by Lieut.-Col. JARED A. SMITH, U. S. Engineer Office, Portland, Me.:—Kennebec river: T. H. Rowe, $1.45 per ton for stone, $2.50 each for fascines, $600 for 2 pier heads; M. J. Wheeler, 99¼ cts., 85 cts., $500; G. W. Andrews, $1.07 and $1.47 for stone, $1.43, $600; A. E. Hamilton, $1.46, $2.25, $525; R. A. Soule, $1.22½, $2.25, $600.——York Harbor: Thomas Symonds, $10 for ledge, 50 cts. for overlying material; Geo. W. Townsend, $10.97, 60 cts.: O. J. Jennings, $11 and 50 cts. for isolated, and $13 and 75 cts. for stage work.——Back Cove channel: Edward Moore, 22 cts. per cu. yd. for dredging: Thomas Symonds, 23 cts.; Bay State Dredging Co., 35 cts.——Bellamy river: Thomas Symonds, 19¾ cts.; Hamilton & Sawyer, 24½ cts.; Bay State Dredging Co., 33 cts.——Moose-a-bec river: Thomas Symonds, 30 cts.; A. K. Wright, 35 cts. Hamilton & Sawyer, 48 cts.——Penobscot river: Thomas Symonds, 30 cts.; Moore & Wright, 53 cts.; Hamilton & Sawyer, 65 cts.

Granite Blocks.—The Street Committee of Charleston, S. C., has awarded a contract to the Winnsboro Granite Co. for 75,000 paving blocks at $62.50 per 1,000.

Sewer Pipe.—The Sewer Committee, Manchester, N. H., received bids from Henry A. Fisk, Pike & Heald, Oscar F. Bartlett, Frank B. Patten, Thomas A. Lane, and Pettee & Adams. The bids all specified Akron pipe, but the latter, which was Portland pipe, and all gave the same price, namely, 45 per cent. off the list price and 2 per cent. off if paid within 10 days. The contract was awarded to T. A. Lane.

Street Work.—*Brooklyn, N. Y.*—The following proposals have been received by the City Works Department for grading and cobblestone paving: Nolan & Kearns, $4.35 per lin. ft.; John Hart, $4.57; Henry Mogk, $4.69; J. S. Bogert, $4.90; D. Gallagher & Son, $4.12. For digging down lots, prices ranged from 23 to 30 cts. per cu. yd.

Baltimore, Md.—The contract for grading and paving Hargrove alley has been awarded by Mr. W. H. SHIPLEY, to HENRY FOX, at 6 cts. per sq. ft. for paving, including grading, 38 cts. for curb and 30 cts. for flagging.

Seattle, Wash. Ty.—The following bids have been received for improving Cedar St.: A. Feek: 25½ cts. per cu. yd. for earth-work, $100 per acre for grubbing, $17 per M. for lumber for sidewalks, cribbing and box drains. W. N. White: 33 cts. for earth and rock, $100 for grubbing; $17 per M for lumber. Whitney & Lemon: 39⅞ cts. for earth-work, $80 for grubbing, $17.75 for lumber. E. C. McClanahan: 31¼ cts. for earth work, $75 for grubbing, $16 for lumber. G. M. Quigley: 29¼ cts. for earth-work, $80 for grubbing, $16 for lumber. The contract was awarded to A. Feek.

Nasheville, Tenn.—The following proposals for about 7,400 yds. of paving were opened March 22 by F. E. KUHN, Secretary of the Board of Public Works & Affairs: Venable Bros., Atlanta, Ga., $2.60 per yd.; Holmes & Wick, Nashville, $2.85; Southern Construction & Quarry Co., Nashville, $3.19; John Broderick, $3.75 per yd. The contract was awarded to Venable Bros.

PROPOSALS OPEN.

Electric Lighting.—About 200 incandescent lights for streets and public places. DAVID TERHUNE, President, Hackensack Improvement Commission, Hackensack, N. J., April 1.

Sewers.—Manholes, basins; 10, 12, and 15-in. pipe; 30 x 45 brick. ERNEST ADAM, City Surveyor, Newark, N. J. April 2.

Tunnel.—For 1,000 ft. of tunnel; 6 ft. high, 2¼ ft. at top, 4 ft. at bottom; the present end of the tunnel is about 1,000 ft., in blasting rock. JOHN SCOTT, Duarte, Los Angeles Co., Cal. April 2.

Sewers.—Manholes, catch basins, 24 and 30-in. brick; 12, 15 and 18-in. pipe. A. B. HILL, City Engineer, New Haven, Conn. April 3.

Supplies.—For Congressional library: 5,000 bls. of natural hydraulic cement; 2,000,000 best red and hard burned brick; 3,000 cu. yds. river sand; 5,500 cu. yds. broken stone; 3,700 ft. lumber. BERNARD R. GREEN, Superintendent and Engineer, 145 E. Capitol St., Washington, D. C. April 4.

Building.—Government building at Charleston, S. C. WILL A. FRERET, Supervising Architect, Treasury Dept., Washington, D. C. April 6.

Railway.—Between Annapolis and Digby, N. S. A. P. BRADLEY, Secretary, Dept. of Railways and Canals, Ottawa, Canada. April 8.

Pipe.—About 3,500 ft. of 6-in. cast-iron water pipe, with special castings; also the 4 and 6-in. pipe required during the current year. H. M. FARNSWORTH, Village Clerk of Brooklyn, 219 Superior St., Cleveland, O. April 9.

Excavation.—For foundation trenches BERNARD R. GREEN, Superintendent and Engineer of Congressional Library, 145 E. Capitol St., Wasington, D. C. April 10.

New Croton Aqueduct.—Iron work for doors, windows, etc., at the gate-house at 135th St. on Section No. 15. Also pipe, lining, iron covers, beam, etc., at Shaft No. 24, on Section A. JAMES C. DUANE, President, Aqueduct Commissioners, 280 Broadway, New York City. April 10.

Bridges.—Building all bridges in Lancaster Co. during 1889. Pile bridges from 10 ft., combination and iron bridges from 30 ft.; price per foot; also price per foot for caissons. Also price for piling, 1,400 lb. hammer. Also repair work. O. C. BELL, County Clerk, Lincoln, Neb. April 10.

Electric Lighting.—D. P. BEATON, Mayor, Oxford, O. April 11.

Galvanized Iron Work.—Galvanized iron and zinc ornamental work for skylights, ceilings, cornice, etc., for the State House. FRANK NIERNSEE, architect, J. S. VERNER, Comptroller General, Charleston, S. C. April 20.

Stone.—For lock in the Wabash river, near Carmel, Ill. Amount available, about $23,000. Major AMOS STICKNEY, U. S. Engineer Office, Louisville, Ky. April 23.

MANUFACTURING AND TECHNICAL.

Engines and Boilers.—The Geo. G. McLaughlin Mfg. Co., of Boston, Mass., manufactures engines, boilers, pumps and appliances. Among their specialties are a hoisting machine, and a patent friction-drum engine for hoisting and pile driving; it is a double cylinder and double drum engine and has been extensively used by dock and bridge builders in New York and Philadelphia. With engines of this type the makers guarantee to strike 15 to 25 blows per minute, running the hammer 12 to 25 ft. high, with a 6¼ x 12 cylinder and 2,500 lbs. hammer, or a 7 x 17 cylinder and 3,000 lbs. hammer.

Channeling Machines.—The Steam Stone-Cutter Co., of Rutland, Vt., is the sole maker of the Wardwell stone channeling and quarrying machines. A circular issued by the company shows different types of the machines mounted on frames and wheels, with boilers, etc., complete.

The Massac Iron Co., of Metropolis, Ill., has completed its works and is now prepared to tender for cast-iron pipe up to 12 ins. diameter and for special castings. The works have a daily capacity of 50 tons of pipe and specials. J. M. THOMAS is Secretary.

Derricks.—The Excelsior Iron Works, Cleveland, O., have an order for 6 Thornberg derricks for the Delaware & Lackawanna Ry. They will be used at Buffalo, N. Y., for transferring iron ore from ships to cars.

Bridge Works.—The Youngstown Bridge Co. is to be organized to build works on the site of the works of the Morse Bridge Co. which were destroyed by fire. Capital stock, $100,000. B. F. BOYD, HAMILTON HARRIS, ROBERT HUNTER, L. E. COCHRAN, and JAMES NEILSON are interested.

Paving Bricks.—The Peoria Paving Brick Co. has been organized at Peoria, Ill., and will build works with a daily capacity of 50 to 100 tons. Nicol, Burr & Co. have the contract for the engines and Cody & Lamb for the boilers.

Natural Gas.—The Equitable Gas Co., of Pittsburg, Pa., has increased its capital to $1,000,000 and has let contracts for a line of 30 and 24-in. cast-iron pipe from the Murraysville field to the city. President, ROB. B. BROWN; Secretary, THOS. H. ALLDRED; Engineer, W. D. HEMPHILL.

The National Water-Tube Boiler Co., of New Brunswick, N. J., manufactures the Moore water-tube boiler and the Standard rocking grate.

Wyckoff Pipe.—Ayrault Bros. & Co., of Tonawanda, N. Y., have issued their catalogue for 1889 of the Wyckoff wooden water pipe and steam pipe casing. A large number of testimonials are given.

Pumping Plant.—The Buffalo Steam Pump Co., of Buffalo, N. Y., has been awarded the contracts for the pumping machinery for the water-works at Gladstone, Mich., Clyde, N. Y., and Smiths Centre, Kan.

Feed-Water Heaters and Purifiers are manufactured under the Stilwell patents by the Stilwell & Bierce Mfg. Co., Dayton, O. The open heater, using exhaust steam, is sufficient where the water contains only carbonates of lime and magnesia; but for water containing sulphates of lime and other impurities which require a greater degree of heat than that of exhaust steam, to be precipitated, the live steam purifier is recommended, as it supplies the feed at about the same temperature as the water in the boiler, and free from scale producing impurities. A horizontal live steam purifier is made for use where an exhaust steam heater cannot be applied. The scale producing impurities are deposited on pans and other impurities are precipitated as mud, while the water passes through a filter chamber before entering the boiler.

Cars.—The Indianapolis Car Works, of Indianapolis, Ind., are building 500 fruit cars for the Louisville & Nashville and 100 box cars for the Jacksonville & Southeastern.

The Pullman Car Works, of Pullman, Ill., are building 50 passenger cars for the Philadelphia & Reading and 1,000 box cars of 50,000 lbs. capacity for the Cleveland, Columbus, Cincinnati & Indianapolis.

J. G. Brill & Co., of Philadelphia, Pa., are building 6 cars for the Julien Electric Company for use on the Fourth Ave. surface line in New York.

The Ellis Car Co., of Amesbury, Mass., is building a double-story car for the Boynton Bicycle Ry. Co.; it is 42 ft. long, 4 ft. wide and 13 ft. high (See ENGINEERING NEWS, March 2, 1889).

The Pennsylvania R. R. Co. will add a large number of new cars to its freight equipment.

The Michigan Central has built another handsome dining car at its West Detroit shops. Eastern members attending the last convention of the Am. Soc. C. E. will remember the fine car built by this company which was used on the special train.

Cement.—The American Proof Cement Co., of Egypt, Pa., has filled an order for the Giant brand of Portland cement for government work in the city of Tokio, Japan. This is said to be the first shipment of American cement to Japan.

Castings.—The Crown Smelting Co., of Chester, Pa., has orders for large castings made of gun metal to be used in sugar making machinery; the dimensions are 8 ft. in diameter, containing 604, 2¼ cores with an 18-in. center core and 8 8-in cores, also a number of large rolls from 10 to 15 ft. long and 12 to 18 ins. in diameter. Orders are also on hand for engine and other bearings to be made of the Crown bronze metal.

Locomotives.—The Rhode Island Locomotive Works, of Providence, R. I., built the engine which has been making fast time with the vestibule train between Savannah and Jacksonville on the Savannah, Florida & Western road. Cylinders, 18 x 24 ins.; 6-ft. drivers; 181,820 lbs. weight.

The Schenectady Locomotive Works, of Schenectady, N. Y., have built a combination locomotive and observation car for Chief Engineer SWIFT of the Delaware & Hudson.—Two other engines were turned out last week.

The Rogers Locomotive Works, of Paterson, N. J., have an order for 7 consolidation engines for the Louisville & Nashville.

The Dickson Locomotive Works, of Scranton, Pa., have delivered 2 passenger engines to the Delaware & Hudson.

The Richmond & Danville is having 10 new engines built, 2 of which are being built at Richmond, Va.

The Fairhaven & Southern road, in Washington Territory, has ordered 2 ten-wheel engines; also 56 lb. rails, etc. A. P. FISKE, of 66 Broadway, New York, is the purchasing agent.

Artesian Well.—An artesian well is wanted to be bored for H. & D. Henry, 64th and South Sts., Philadelphia.

The Robert Poole & Son Co. is the new name of the firm at Baltimore, Md., carrying on the foundry and machine business formerly conducted by Poole & Hunt, and more recently by Robert Poole & Son. President, ROBERT POOLE; Vice-President and General Manager, GEORGE POOLE; Secretary, MILLARD S. BLACK.

Printing Presses.—The Colt's Armory printing presses, manufactured by JOHN THOMSON, of New York, have been awarded the only first award and the only "special mention" for platen printing machines at the recent exhibition at Melbourne, Australia. There was a large exhibit of printing machinery from England, France and Germany. Mr. THOMSON is the inventor of the Thomson water meter.

The Priestman Petroleum Engine, which is on exhibition at 106 Washington St., New York, is being used to run a dynamo with 25 lights of 16 c. p. The engine was described in ENGINEERING NEWS, Nov. 17, 1888.

Rock Drills.—The Ingersoll-Sergeant Rock Drill Co., of New York, sold 3 large tunnel plants, comprising 5 air compressors, 5 air receivers, 4 boilers, pipe, etc., in one week after its organization by the consolidation of the Ingersoll and Sergeant companies; 5 stone channeling machines were sold during the week. Orders have been received for several mining plants, and recent shipments have been made to Mexico, India and Wales. Complete quarrying outfits, including hoisting engines, boilers, drills, pumps, etc., have been shipped to several States. It is claimed that every tunnel now under construction in the United States is being driven exclusively with Ingersoll or Sergeant machinery.

BRIDGES AND CANALS.

Canals.—At Pensacola, Fla., it is proposed to cut a canal from the Bay to Lake Chipley at a cost of $10,000.

The Schuylkill canal, Pennsylvania, has been opened for navigation.

Viaducts.—*Kansas City, Mo.*—The contracts for the Fourth St. viaduct have been let to Sullivan & Keating for the substructure and the Wrought Iron Bridge Co., of Canton, O., for the superstructure.

Pueblo, Col.—The City Council has passed an ordinance appropriating $25,000 for a new viaduct over the railway tracks on Union Ave.

Bridge Notes.—*Quincy, Mass.*—The city contemplates building a pile bridge across the Neponset river this spring, 630 ft. long and 40 ft. wide. Bids will be received as soon as plans and specifications can be prepared. JOHN P. PRICHARD is Commissioner of Public Works.

Rochester, N. Y.—The following were the bids received for the Driving Park Ave. bridge over the river: Rochester Bridge & Iron Co., $101,936.19; King Iron Bridge & Mfg. Co., Cleveland, O., $104,642.71; Wrought Iron Bridge Co., Canton, O., $104,882.13.

Troy, N. Y.—The Troy & Green Island Bridge Co. is to be incorporated by JOHN E. GAITLEY, J. G. MANNING, THOMAS S. FAGAN and others, to build a bridge over the Hudson from Douw St., Troy, to Green Island. Capital stock, $150,000.

Parkersburg, W. Va.—Plans have been prepared for the approach to the new bridge.

Cumminsville, O.—A bill has been passed authorizing the construction of an iron bridge over Mill creek at Colerain Ave., at a cost of $40,000.

Logansport, Ind.—Two iron bridges will be built this season; one with 4 spans of 150 ft. and one with 3 spans of 125 ft. WALTER A. OSMER, City Engineer, will have charge of the work.

Alton, Ill.—The Union Bridge Co., of New York, will build the substructure and superstructure of the bridge for the Cleveland, St. Louis & Kansas City Ry.

Sioux City, Ia.—Work has been commenced on the pontoon bridge, and is to be completed by May 15. Gen. LYMAN BANKS, who built the pontoon bridge at Nebraska City, Neb., is in charge of the work.

St. Louis, Mo.—The contract for broken stone for

concrete for the Merchants' bridge has been let to Henry Watson, of Alton, Ill.

Kansas City, Mo.—All the bids for the substructure of the Winner bridge have been rejected, and new bids will be received until April 15.

Pueblo, Col.—The Bullen Bridge Co, has contracts for 3 bridges over the Arkansas, 2 will be 22 ft. wide and the third 38 ft. wide.

The Philadelphia & Reading is to build a bridge by the side of the present one at the Falls of the Schuylkill. Trains from the Baltimore & Ohio road will then be able to run directly to the Bound Brook line.

New Westminster, B. C.—The Canadian Pacific has selected a site for a bridge over the Fraser river at a point 24 miles above the city. The contract for piers and approaches have been let to D. McGillivray, of Vancouver. The estimated cost is $200,000.

Yorkton, No. W. Ter.—Proposals have been asked for the construction of a bridge over the Yorkton branch of the White Sand river.

ELECTRICAL.

Electric Light.—*Providence, R. I.*—The contract with the Narragansett Electric Lighting Co. for 75 lights, which expired March 1, has been renewed at 50 cts. per light per night; the contract for the balance of 175 lights expires June 15.

Adams, Mass.—The Adams Electric Light & Power Co. has been organized and will put in an arc and incandescent light plant and will operate the street railway. The company has made a proposition to put in 30 arc lights of 1,200 c. p. at $82.50 each.

Holyoke, Mass.—The water power company has put in a complete plant for arc and incandescent lighting and for power.

Lebanon, Ky.—The Lebanon Electric Light Co. has been incorporated and has been granted an exclusive franchise for 15 years. Capital stock, $15,000. President, JOHN RUBEL; Secretary, W. T. GOODNOW.

St. Louis, Mo.—The Laclede Gas Light Co. has been awarded the contract for incandescent lighting in the northern district, at $33,327.80, and the Missouri Electric Light & Power Co. has the contract for incandescent lighting in the southern district, at $50,525. The contracts for arc lighting in both districts were awarded to CHARLES SUTTER at $81,659 for the northern and $84,680.50 for the southern district.

San Marcos, Tex.—The San Marcos Electric Lig ht Power Co. has been organized by JOHN COOK, J. S. GREEN and L. W. COOK. Capital stock, $10,000.

Albina, Ore.—The city has been authorized to issue $15,000 in bonds for an electric light plant.

WATER AND MUNICIPAL.

Memphis, Tenn.—The reports of NILES MERIWETHER, City Engineer, and R. F. HARTFORD, Engineer of Sewers, contained in the biennial report of DAVID P. HADDEN, President of the Fire and Police Commissioners, give very full particulars of work done during the 25 months from Dec. 1, 1886, to Dec. 31, 1888; detailed statements are given showing the cost of different kinds of pavement. The defects and requirements of the sewerage system are considered.

Plymouth, Mass.—The Water Commissioners have issued their report for 1888. The pumpage for the high service was 97,500,356 galls. and the consumption of the low service was estimated at 150,000,000 galls. There are now 148,993 ft. of main and distribution pipe, 26,776 ft. of service pipes and 242 gates. R. W. BAGNELL is Superintendent.

Dayton, O.—The Trustees of the Water-Works have issued their report for 1888. During the summer a Smith & Vaile pump of 1,000,000 galls. daily capacity was hired at a monthly rental of $100, to guard against emergencies; it was used for 6 months. In September a contract was let to the Holly Mfg. Co., of Lockport, N. Y., for a 10,000,000 galls. Gaskill engine. During the year 12 miles 4,000 ft. of pipe were laid and 147 hydrants set. The water supply has been analyzed and is reported to be of excellent quality. The supply is taken from 30 8-in. wells, 40 ft. average depth, the location of which is shown on a plan. The pumpage for the year was 725,630,700 galls. There are now 49 miles 3,411 ft. of pipe.

Boston, Mass.—The Water Board has issued its report for 1888. During the year about 20 miles of pipe were laid and 5,000 sidewalk stop-cocks set. The quality of the water has been good; the consumption averaged 88 galls. daily per capita on the Cochituate and Sudbury systems and 76.5 on the Mystic system. The Mystic Valley sewage disposal works are described. There were 3,133 meters in use at the end of the year on the Cochituate division and 387 on the Mystic division. The report contains very full particulars of the conditions of the works, rainfall, etc. It is illustrated with cuts and plans of the new Chestnut Hill pumping station, Bellevue Hill tower and Mystic Valley sewage works, and has also diagrams of consumption, etc. DEXTER BRACKETT is Superintendent; DESMOND FITZGERALD, Resident Engineer of Additional Supply; WM. JACKSON, City Engineer and Engineer to the Board.

Cuba, N. Y.—The Village Trustees received 9 bids for the construction of the water-works: S. L. King, of Randolph, and Geo T. Keith, of Orleans, $22,100; New York Pipe Mfg. Co., 18 Cortlandt St., New York, $22,406.78 (Phipps cement lined pipe); M. Sullivan, Little Falls, $22,955.05 (allowance made for difference in market value of the 3-in. wrought-iron or Wyckoff wood pipe), Ayrault Bros. & Co., Tonawanda, $23,600 (Wyckoff wood pipe); Adam Miller, Saratoga Springs, $24,500; Morgan & Reynolds, Cuba, $25,774.25; M. McMahon, of Rochester, and J. McMahon, of Bradford, Pa., $26,002. The ninth bid was informal. The contract was awarded to S. L. King and G. T. Keith. The work is as follows: reservoir of 500,000 galls. capacity; 2,540 cu. yds. earth excavation, 205 cu. yds. rock excavation, 1,005 cu. yds. puddle in place, 27 cu. yds. rubble masonry, 8 cu. yds. dry masonry, 1 cu. yd. concrete, 5 sq. yds. paving, 841 sq. yds. rip-rap wall; 24 ft. of 10-in. cast-iron pipe, 3,660 ft. of 8-in., 9,000 ft. of 6 in., 10,620 ft. of 4-in., 12,900 ft. of 3-in., strengthened Wyckoff pipe, 1,100 ft. of 8-in. vitrified sewer pipe, 36 double nozzle fire hydrants, 2 8-in. gates, 5 6-in. gates, 7 4-in. gates, 1 4-in. relief valve, 4 straightway valves; also the necessary specials.

Morrisonville, Ill.—The water-works built by the Water, Light & Power Co., of St. Louis, Mo., have been accepted. There is a tank of 40,000 galls. capacity and a duplex pump of 250,000 galls. daily capacity. The mains are of cast-iron, and services of galvanized iron; there are 20 services. Cost of works, $7,500. No franchise. A. L. MCAULEY is Engineer and Superintendent.

Gas Works.—*Greensboro, N. C.*—A franchise for establishing gas works has been granted to Conway, Kelly & Co., of Lebanon, Ky.

Port Townsend, Wash. Ty.—The Port Townsend Gas Co. has been organized. President, J. A. KUHN; Treasurer, W. I. HASTINGS; Secretary, CHAS. A. DYER. Capital stock, $60,000.

Irrigation.—*Wyoming.*—Surveys have been made by Mr. CHAS. BELLAMY for a scheme to irrigate the southern portion of the Laramie plans. Water is to be taken from the Big Laramie river.

Colorado.—The Oxford Ditch Co. has been incorporated at Pueblo by L. HARTIG, C. W. TAYLOR, J. S. GARLAND, and others.—The Arkansas, St. Charles & Huerfano Ditch Co. has been incorporated at Pueblo, with a capital stock of $300,000.—Water has been let into the Fountain Lake subdivision ditch, near Pueblo. The ditch is 7 miles long.

California.—The Paso irrigation district, at Delano, has voted to issue bonds for $500,000 for irrigation works; water to be taken from Paso creek.—The San Felipe & Desert Land & Water Co. will dam the San Felipe river and establish irrigation works.

East Saginaw, Mich.—The Water Commissioners have issued their report for 1888. The average daily pumpage was 3,075,456. A new engine has been contracted for, to be paid for out of the receipts. There are now 40½ miles of 2 to 20-in. cast-iron distribution pipe, 270 hydrants and 318 valves. H. M. NEWTON is Secretary.

Artesian Wells.—*Barnwell, S. C.*—The new artesian well is about 450 ft. deep, and the water rises to within 10 ft. of the surface. Mr. CLAY is the contractor.

Columbus, Ga.—The city will bore for artesian water. For particulars, address the mayor.

Vinton, Ia.—The artesian well is down 1,050 ft. and yields about 300 bls. of water per hour.

Trinidad, Col.—An artesian well has been put down about 55 ft.

Carbon, Wyo.—Work is to be begun shortly on an artesian well.

Pasco, Wash. Ty.—Work on the artesian well is still in progress.

Petaluma, Cal.—A well has been put down 360 ft.

Independence, Cal.—Boring machinery has been received from New York for sinking wells in Owens valley to furnish water for irrigation.

Cordele, Ga.—The contract for boring the artesian well was awarded to D. C. FITCH, of Hawkinsville.

Florence, S. C.—A local company is to be organized to sink an artesian well. For particulars address R. C. STARR, Jr.

Laredo, Tex.—The Texas Irrigation & Land Co. want bids for plant or for putting down wells. Address H. C. FLOOD, Secretary.

Water-Works.—*Massachusetts.*—Stockbridge. A new water company has applied for a charter. HENRY J. DUNHAM, F. J. PRATT, and C. H. WILLIS are interested.—Malden. An appropriation of $6,000 has been made for the purchase of 8, 10 and 12-in. pipe to be laid to Eaton's wells.

New York.—Gloversville. The water-works will be built next summer. J. J. HANSON is President of the Water Commissioners, and S. S. GROSS is Secretary.—Patchogue. The Suffolk County Water Co. is receiving orders from new consumers. President, J. LOCKWOOD; Superintendent, S. A. SOUTHER.—Brooklyn. Mr. JOHN P. ADAMS, Commissioner of City Works, has written another letter to try and induce the Aldermen to authorize the expenditure of the $2,500,000 already provided for work on the water-works extension.—Greenport. The contract for water-works at Greenport and Sag Harbor has been let to CHAS. K. MOORE, of 121 Liberty St., New York. There will be about 6 miles of pipe, and the water will be pumped to stand-pipes of 200,000 galls. capacity each. The cost will be about $75,000.—Green Island. The water company will erect two tanks this spring to enable the pumps to be stopped during the night.—Pike. Water-works are projected.

New Jersey.—Newark. The Council has accepted the proposition of the Lehigh Valley Ry. Co. to supply the city with 50,000,000 galls. daily from the Ramapo watershed. The city has the option of purchasing the plant for $6,000,000.

Virginia.—Roanoke. Work has been commenced on the repairs of the south basin of the reservoir under the supervision of the engineer, Mr. HOWARD MURPHY, of Philadelphia.

West Virginia.—Bridgeport.—It is proposed to obtain a supply from Martin's Ferry, the city to lay its own pipes, and Martin's Ferry to extend its pipes to the Bridgeport line.

South Carolina.—Orangeburg. Philadelphia parties have made an offer to alter and extend the water-works if granted a franchise.

Florida.—Fernandina. The contract for the construction of the water-works has been let to the Jeter & Boardman Water & Gas Co., of Macon, Ga.

Mississippi.—Meridian. The Meridian Water-Works Co. will improve its plant, put in new boilers, etc. President, W. W. GEORGE.

Tennessee.—Nashville. Work is progressing on the new reservoir and is expected to be completed by September. It will have a capacity of 50,000,000 galls. It is suggested that the second pumping engine be purchased now, as it will take about a year to build.

Kentucky.—Winchester. Water-works are projected.—Owensboro. The water company is improving its plant and will put in a new pump.

Ohio.—Findlay. The City Council has sold $50,000 of additional water bonds to A. L. Spitzer, of Toledo.

Illinois.—Jerseyville. The contract for building the water-works has been let to the Rockford Construction Co., of Rockford, Ill., for $21,875. The works are to be completed by August.—Carlyle. The decision against the contractors rendered by the Circuit Court in May, 1888, has been reversed by the Appellate Court.—Springfield. During the year ending Feb. 28, 15,300 ft. of pipe were laid and 14 hydrants set; there are now 33 miles of pipe, 147 hydrants and 1,580 connectors; 900 ft. of water gallery was built at a cost of $10,000, including pipes, engine, etc.; this gallery yields about 1,500,000 galls. per day.

Nebraska.—Bancroft. Water-works are projected.—Lincoln. The Deane Steam Pump Co., of Holyoke, Mass., will put in a vertical engine of a new design, with a daily capacity of 1,500,000 galls.

Missouri.—Marceline. Water-works are projected and will probably be built soon.

Texas.—El Paso. The city has asked the water company to name a selling price. If the sale is not effected it is proposed to issue bonds for the building of new works.—San Marcos. The water company will put in new machinery. For particulars address Dr. JOHN COOK.

Colorado.—Greeley. Pipe-laying for the new works is progressing rapidly. The $60,000 6 per cent. bonds have been sold to N. W. Harris & Co., of Chicago.—Akron. The railway company obtains a plentiful supply of water from its new well.—Longmont. The water mains are being extended to the south fork of the St. Vrain.

Oregon.—Albina. The water company is laying its mains. The city has been authorized to issue $40,000 in water bonds.

Washington Territory.—Sehome. The City Council has granted a franchise to the Bellingham Bay Water Co. Water is to be piped from Lake Whatcom and is to be supplied within 6 months.

Canada.—Picton, Ont. The town offers for sale water-works debentures for $30,000; proposals will be received until April 15. For particulars address Mr. W. J. CRANDALL, Chairman of the Finance Committee.—Winnipeg. During the past year the water company laid 7 miles of mains and 33 hydrants and added three 10-ft. filters to its plant. President ALEX. MOFFAT; Vice-President, HEBER ARCHIBALD.

Sewerage.—*Circleville, O.*—An ordinance has been passed authorizing the taking of a vote on the question of establishing a sewerage system.

Charleston, W. Va.—An ordinance has been passed providing for extending the sewerage system.

Parkersburg, W. Va.—The city council is contemplating the establishment of a sewerage system.

Americus, Ga.—The city has voted to issue bonds for $35,000 for building a sewerage system.

Glenwood Springs, Col.—The taxpayers will vote April 2 on a proposition to issue bonds for a system of sewers.

Water Power.—The Bartlett Water-Power Transmission Co. has been organized at Chicago by CHAS. M. BARTLETT, THEODORE NELSON and JOHN MCDONALD. Capital stock, $250,000.

New Croton Aqueduct.—On March 28 Mayor GRANT, with Chief Engineer A. FTELEY and Commissioner SCOTT visited the shafts and tunnel of the Harlem river section of the new aqueduct.